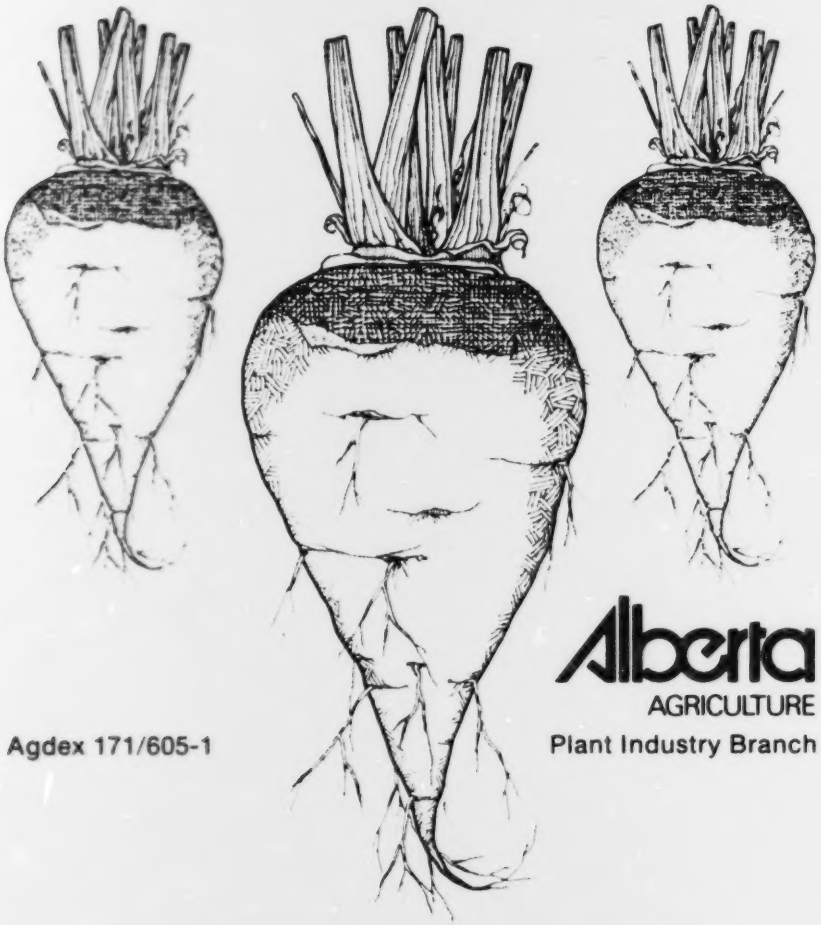
GUIDE TO CHEMICAL WEED & INSECT CONTROL IN SUGARBEETS



Alberta
AGRICULTURE
Plant Industry Branch

Agdex 171/605-1

84- 3342 /

Copies of this publication may be obtained from:

Print Media Branch
Alberta Agriculture
7000 – 113 Street
Edmonton, Alberta, T6H 5T6
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Alberta Agriculture's district offices

1984 03 3M

GUIDE TO

CHEMICAL WEED AND INSECT

CONTROL IN SUGARBEETS

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This publication is to a large extent a compilation of information that was available in separate publications that had been prepared by personnel from Agriculture Canada, Alberta Agriculture, Alberta Sugar Company and the Chemical Industry. It contains selector charts and fairly detailed descriptive texts on chemicals to assist the producer in planning his weed and insect control program.

The information and recommendations given in this Guide are not a substitute for, nor do they supercede, the instructions on the label of a pesticide. Label directions should be followed carefully whenever pesticides are used. Agriculture Canada, Alberta Agriculture and Alberta Sugar Company accept no responsibility for the performance of any pesticide. The user accepts full responsibility for their proper and safe use.

A PESTICIDE MAY BE LEGALLY USED IN THE PRODUCTION OF SUGARBEETS: (a) IF THE PESTICIDE IS REGISTERED FOR SUCH PURPOSE; and (b) THE PESTICIDE IS APPLIED AT RATES NOT EXCEEDING THOSE PRESCRIBED ON THE LABEL; and (c) THE PESTICIDE IS APPLIED AS PRESCRIBED ON THE LABEL.

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TO DETERMINE:

(ha)	hectares	multiply acres by 0.405
(L)	litres	multiply imperial gallons by 4.55
(kPa)	kilopascals	multiply PSI by 6.9
(km/h)	kilometres per hour	multiply MPH by 1.61
(cm)	centimetres	multiply inches by 2.54

INTRODUCTION

This guide is intended to supply specific information on the chemical control of weeds and insects that may be problems in the production of sugarbeets in southern Alberta. This introduction deals with the crop in a general way.

In southern Alberta, sugarbeets are grown only under contract with the Alberta Sugar Company, which has the facilities to extract and refine the sugar.

Description of the Crop

The sugarbeet is a biennial plant that stores sugar in the tap root during its first year of growth and will produce seed the second year. Sugarbeets that are produced for sugar are harvested at the end of the first year of growth. Sugarbeet yields average 15 to 18 tonnes per acre (37 to 44 tonnes/hectare), but yields of over 20 tonnes per acre (50 tonnes/hectare) are common. Depending on genetic and environmental factors, the sugarbeets contain from 12 to 18 per cent sucrose.

Soil & Soil Fertility

In Alberta, sugarbeets are grown under irrigation on a wide range of soil types with the medium textured soil being best. Proper tillage, fertilizer use, and irrigation practises greatly influence yields. Sugarbeets are fairly salt tolerant; however, establishing good plant stands under saline conditions can be difficult especially if the soil moisture is low.

The use of a soil test to determine soil fertility levels is a useful managerial tool. About 34 to 50 kilograms per acre (85 to 120 kilograms per hectare) of actual nitrogen are required for maximum yields, and the recommended rate for phosphorus (P_2O_5) is 26 to 36 kilograms per acre (65 to 90 kilograms per hectare). A soil test may indicate that lesser amounts are required. To achieve the best overall results the recommended amount of fertilizer should be broadcast in the fall and plowed under.

Recommended Cultural Practises

The most widely recommended practice, which is the result of many years of production experience, is to do most of the land preparation in the year before planting the crop. The land should be fall irrigated to ensure good soil moisture conditions for seed germination in the spring.

Seeding should be done with a minimum amount of tillage in order to maintain the moisture level to within the top 2.5 cm of the soil. Sugarbeet seed, which is treated with a fungicide before packaging, is quite small and must be planted no deeper than 3.8 cm. The recommended plant population is between 24,000 and 36,000 plants per acre (59,000 and 89,000 plants per hectare), which is 100 to 150 plants per 30 meters of row in rows spaced 56 cm apart. Seeding is normally done from mid-April to mid-May using precision planters.

Technological advances in equipment, irrigation methods and scheduling, herbicides, seed protectants, and monogerm seed, has made it possible to greatly reduce the seeding rate to achieve the required plant population. The trend is to plant to final stand, with the seeds spaced 15 to 18 cm apart.

Sugarbeets require a long growing season, therefore they should be planted early and harvested before the ground freezes and makes digging impossible.

Weed Control

Cultural and chemical weed control practices can be used to control weeds. Weed control begins with the land preparation in the fall. Working the land and fall irrigating creates favorable conditions for many weed seeds to germinate and the seedlings are destroyed by frost. Cultural control in the spring is basically by inter-row cultivations. When the beets are larger the soil between the rows can be moved against the beets by the cultivator to smother the small weed seedlings in the row.

Chemical control of most weeds can be achieved by pre-plant and post-emergence application of herbicides. The list of names and methods of application of these herbicides are given in detail in this publication.

Pests

Pests other than weeds may also be present in fields. For cultural control it may be stated that any agronomic practice that will normally maximize yields will also minimize insect damage. Some of the more common insects that can become problems in crops are root maggots, leaf miners, flea beetles, webworms, redbacked cutworms and wireworms.

These insects can be controlled by using the appropriate chemical insecticides. Detailed information regarding the control of insects, is given in this guide.

Sugarbeet nematodes are potentially a serious threat to the industry. Although they are present in many fields, their numbers do not reach economic levels unless beets or other susceptible crops are grown too frequently. The only practical method of control is through a proper crop rotation. Chemical control is possible but very expensive.

Irrigation

Irrigation of sugarbeets in southern Alberta is a must. Sugarbeets require about 56 cm of moisture throughout the growing season. In southern Alberta, irrigation water is applied to the crop either by sprinkler or flood systems. Scheduling and application amounts are important, however, the key to high level beet production is to keep the soil moisture high. Under no circumstances should the crop suffer from lack of moisture. Moisture stress definitely cuts yields. Fall irrigation ensures the crop has an adequate moisture supply to mid-June the next year. If it is necessary to irrigate to get the seeds to germinate because of dry conditions, soil crusting may occur. Also, if it is necessary to irrigate very small beet plants, the cooling effect of the water on the soil can set back the rate of growth of the crop to some degree. From a practical point of view, the fall irrigation is extremely important in that it can eliminate most of these early season problems, and let the producer concentrate on other operations in the spring without worrying about irrigating.

Harvesting

Harvesting sugarbeets is usually started around the end of September and carries on through October. Harvesting is usually done mechanically, in a two stage operation. In the first operation, the top growth is removed. Machines designed for this purpose cut the tops off one to six rows of beets and pile them into windows or scatter them between the rows. These tops are a source of high-value cattle feed. The tops may be left in the field for cattle to graze or may be ensiled. The second stage in the harvesting operation is the digging of the roots which then pass over a series of chains to remove most of the soil adhering to them. They are then elevated into trucks and delivered to sugar company receiving stations that are located throughout the district. At the receiving station, they are weighed, unloaded and piled. Soil, leaves, etc. are removed and loaded back onto the producer's truck. The beets remain in these piles until the sugar factory requires them for processing. They are then transferred from these storage piles to the factory by truck for processing.

By-Products

Although refined sugar is the main product of the sugarbeet industry, several by-products are also produced. The fibrous material that remains after the sugar is extracted is dried, pressed into pellets, and marketed as a high value livestock feed: beet pulp. The remaining beet juice, feed molasses, is also sold mainly as a livestock feed.

The Sugar Company

In southern Alberta, the Sugar Company's main objective is to refine and market sugar. In addition, the Company offers a variety of services to its producers. They have a staff of agricultural fieldmen to advise on sugarbeet production, and they market fertilizer and supply application equipment.

The company is also involved in several research programs. They conduct field trials to evaluate new seed varieties, herbicides, insecticides, fungicides and other agronomic practises.

The sugar industry is a major contributor to the economy of southern Alberta irrigated areas and through its nearly 50 years of existence has injected hundreds of millions of dollars into farming and farming related activities.

PRECAUTIONS

Practise safety in using herbicides and insecticides. Skill, experience and knowledge make a safe worker in the field.

Know and observe the following guidelines:

1. Read label carefully before using product.
2. Never smoke while applying pesticides.
3. Avoid inhaling sprays or dusts. Wear protective clothing and respirator when directed on the label.
4. Sprayer lines carrying pesticide must not enter the operator's cab.
5. Have soap, water and towel available. Should concentrated product spill on skin, hands, face or eyes, wash immediately.
6. Wash hands and face when leaving the treated area, before break periods, lunch, or for comfort.
7. Bath or shower and change to clean clothing after working with pesticides. Wash clothing each day before re-use.
8. Call a physician or get the patient to a hospital immediately if symptoms of illness occur during or shortly after pesticide application. Be sure to take along the product label or container.
9. Store pesticides out of reach of children.
10. Store pesticides where there is no chance of contact with human food or livestock feeds. Do not store herbicides with insecticides, and avoid cross-contamination.
11. Keep chemicals in their original containers, never in unmarked containers or bottles used for food or drink.
12. Never fill sprayer directly from a potable water source such as a well or dugout.
13. Follow proper container disposal methods.
14. The LD_{50} is a measure of toxicity, the lower the LD_{50} the higher the toxicity.

IN CASE OF ACCIDENT OR POISONING WITH ANY PESTICIDE, CONTACT YOUR LOCAL HOSPITAL.

WEED CONTROL

Sugarbeets are generally poor competitors against weeds, especially in the early part of the season. Therefore, weed control is very important since even a low population of weeds, established early in the season, will reduce crop yield.

Weed control should be practised in all crops in the rotation. Many broadleaf weeds are more easily controlled in cereal grain crops, than in sugarbeets since the margin of chemical safety is usually greater and crop competition more pronounced.

It is possible to control most weeds that infest sugarbeet fields with herbicides. The degree of control and the length of the control period will depend on the herbicides used, the time and method of application, and the environmental conditions.

Herbicides are fairly specific as to the degree of control they give of specific weeds and the spectrum of weeds they control. Each herbicide has it's unique characteristics and mode of action. This requires that the appropriate method and time of application be used in order to obtain the expected results.

The herbicides registered for use on sugarbeets include some that must be soil incorporated and some that must be applied post emergent to the weed. Since no single herbicide or method of application controls the entire spectrum of weeds, best overall weed control is usually achieved when both soil applied and post-emergent herbicides are used in the same field. Specialized equipment is available to achieve the accurate placement of the specified rates of herbicide. The emphasis has been on band applications of the herbicide on the row coupled with inter-row tillage. This greatly reduces the amount of herbicide applied and the cost of producing the crop.

Herbicides requiring soil incorporation for activity may be applied in the fall preceding sugarbeets or in spring prior to planting. Spring incorporation is frequently associated with the loss of moisture required for seed germination. This problem favours fall incorporation of soil applied herbicides. Post emergent herbicides are all applied after the weeds have emerged. Except for Gramoxone, these may also be applied after the sugarbeets have emerged.

Some sugarbeet herbicides have very unique characteristics that require very specific mixing or application procedures. <u>It is very important that these detailed instructions given on the label be followed</u>.

Great strides have been made in the development of increasingly effective herbicides. Likewise agronomic practices used by the sugarbeet growers have improved very significantly with the result that yields have been steadily increasing. Concurrently the amount of hand labor used in the field has been steadily decreasing. However, as sugarbeet growers strive for higher yields of sugarbeets without the use of any hand labor in the fields, they are faced with at least two intermittently recurring problems that frustrate their efforts.

These two problems are that of: (1) inconsistent stand establishment, and (2) inconsistent weed control. These have been the two most persistent and stubborn problems, at least in the semi-arid area of Southern Alberta.

In our semi-arid area the most successful use of pre-emergent herbicides is restricted to the use of pre-plant soil incorporated herbicides. The commonly accepted procedure is to apply herbicides overall in spring and immediately incorporate them into the soil through the use of vibrashank cultivator followed by mulcher harrows and soil packers. On the whole this procedure has worked well and has been a big help in weed control. However, this practise has two important drawbacks:

(1) The soil disturbance during herbicide incorporation in spring causes the seed beds to dry out resulting in germination and plant establishment problems;
(2) The newer more effective herbicides are too costly for broadcast applications, and some may leave too much herbicide residue for succeeding crops if applied on an overall basis.

An agronomic technique involving fall ridging has been evaluated on a research basis and developed for commercial scale use in Southern Alberta.

FALL BANDING OF SUGARBEET HERBICIDES WITH RIDGING

The fall banding technique involves the application of a soil applied herbicide in autumn, to a properly prepared field. The herbicide is layered in a band slightly below the soil surface. This band of herbicide is covered with a ridge of soil for the winter. In spring the furrows between the ridges are renewed to destroy early germinating weeds and then the ridge of soil is DE-ridged to slightly above original ground level. A shallow mulch (1.25 cm) of loose soil is made. allowed to dry, and then seeds are planted into the center (16 cm apart) of this herbicide treated band. Although the top 1.25 cm of loose surface is dry the seed is placed 3.2 cm below soil surface into the undisturbed firm moist soil. A soil guidance system is used throughout all operations to guide both the tractor and rear mounted implements during planting and subsequent operations.

During the fall, winter and spring the herbicide that was placed in a layer moves up and down treating a thick band of soil. This treated band of soil is firm and moist in spring thus contributing to good herbicide activity on germinating weeds. The shallow mulching on the other hand dries out only the surface soil for easy drilling. The beet seed is placed underneath this dry surface into the band of moist undisturbed soil.

The ridging system has been proven in light and medium textured soil It will also work in the higher clay soils, but some additional work is needed to improve the mulching technique at DE-ridging and to ensure a surface soil structure resistant to wind erosion.

Fall-Ridging with Kirchner Ridger

The application of herbicides in fall together with fall ridging has proven to be a big help toward labour-free beet production. On the whole the system works well, but refinements are continually being made.

Land Preparation

Prior to ridging, fields should be worked at either right angles or parallel to direction of rows.

The soil should be uniformly firm and level.

The soil should have a good moisture content to provide for good herbicide action and germination. When the herbicides are sprayed onto dry soil, the weed control will very likely be reduced.

Ridger Adjustments

The bottom of the scraper should be 61 cm below the top of the main frame.

The nozzle tip should be 11 cm above bottom of scraper to obtain a 18 cm wide band.

The 3-Pt and/or screw jacks can be adjusted so that the scrapers remove from zero to 1.5 cm of soil where the herbicide is applied.

The nozzles should not be smaller than 8002E and the screens not finer than 50 mesh.

Rates of Herbicide for Fall Ridging

Hectares (acres) treated per container of herbicide - based on a 18 cm wide band with 56 cm rows.

	Low Rate		High Rate	
	Acres	(Hectares)	Acres	(Hectares)
Nortron - per 20 litre pail	13	(5.26)	6.5	(2.63)
Nortron & Roneet			8.75	(3.54)
Nortron- per 20 litre pail	15.5	(6.27)		
Roneet - per 20 litre pail	39.6	(15.9)	26.4	(10.68)
PYRAMIN - per 10 litre pail	8.3	(3.35	6.6	(2.67)

Use low rate on light soils and high rate on the heavy soils.

Some of these herbicides have very specific use and mixing characteristics that have major effects on their effectiveness. Therefore, make sure that you read and follow the label instructions concerning useage of the respective herbicides.

Deridging and Planting

1. Ridger gauge wheels mounted in furrows behind ridger.
2. Two outside ridger shovels and shanks must be equipped with hydraulic rams for raising and lowering.
3. Ridges are renewed to:
   (A) Destroy early weed growth.
   (B) Restore ridges to uniform size and shape to allow uniform ridging.
   (C) Bring up moist lumps of soil, which when dry help to reduce wind erosion.
4. Deridger scrapers fastened to rear of machine:
   (A) Set all scrapers at uniform height.
   (B) Center scrapers on ridge and 56 cm apart.
   (C) Depth of Deridging set to restore the ridged soil to slightly above original flat ground level, about 1.5 cm.
   (D) Mulcher (knife, harrow type, etc.) set to cut about 1.5 cm below deridging scraper.
   (E) It is important to let mulch dry before planting.

NOTE: The soil between rows will not drift if left lumpy and somewhat rough.

5. Guide Grooves
   (A) Attach groove maker (Deer Tongue) in furrow behind ridging shovel and on front side of rear tool bar to run between the rows and deep enough to make a distinct mark in firm ground ahead of the deridger.
   (B) Spacing of soil grooves must correspond to spacing of single rib tires on front of tractor to be used for planting and subsequent cultivation and post-emergent spraying.
6. Planting
   (A) Tractor must be equipped with single rib front tires.
   (B) Do not use conventional row markers.
   (C) Make sure planter unit is centered on center of deridged ridge.
   (D) Plant into firm moist ground just under mulch 3 to 3.8 cm deep
   (E) Planter must be equipped with groove makers to renew the soil grooves in the original mark.

7. Post Spraying and Cultivating

(A) Tractor must be equipped with single rib front tires.

(B) The soil guidance groove must be renewed with each operation following deridging and planting.

(C) Each tool used should be equipped with soil guidance equipment to allow close cultivation and narrow band spraying.

STALE SEEDBED TECHNIQUE

Occassionally, unique situations arise in which a practise called the stale seedbed technique may be used to advantage. This involves spraying a non-selective herbicide such as Gramoxone to destroy all the plants and weeds that have emerged. Some of the situations in which the stale seedbed technique may be used to advantage include:

1) When preplant tillage, required for weed destruction only, is considered undesirable, the sugarbeet seed may be planted and the entire field sprayed either before planting or after planting, but before any beets commence to emerge.

2) When a beet field needs to be replanted, it may be undesirable to destroy the seedbed with tillage. The crop may be replanted into the original rows and the entire field sprayed with a non-selective herbicide such as Gramoxone before any beets commence to emerge.

POST-EMERGENT HERBICIDES

Post-emergent herbicides are generally required whether the field has received preplant soil applied herbicides or not. However, the use of the preplant treatment assists in achieving complete weed control in several ways. Firstly, some of the herbicides available for preplant use control weeds that are not readily controlled with any post-emergent herbicides now available. Secondly, even if the soil applied herbicide only provides a moderate to good level of weed control of the more difficult to control weeds, it may render the surviving weeds more sensitive to destruction by post-emergent herbicides. Thirdly, in some years weather conditions do not allow timely post-emergent spraying. Use of the preplant herbicides decreases the urgency of post-emergent spraying.

The proper use of all herbicides is given in detail in the following pages. Special reference will be made to the use of Betanal and Betanex. These herbicides are unique and growers must be aware of and follow the specific mixing and spray dilution instructions given on the label. Furthermore, research and grower experience has demonstrated that best results are obtained with these herbicides when spraying does not commence until mid-afternoon. Spraying these products earlier in the day may cause very severe injury to the sugarbeets.

The standard use, as described on the label, specifies that Betanal and Betanex be applied to sugarbeets after the two true leaf stage. This has become standard practise. However, by the time all the sugarbeets have achieved this stage of growth, some of the weeds are often too big to be controlled.

A new approach is being developed that appears very promising. This consists of applying very low rates onto beets and weeds that are still in the cotyledon stage. As the result of research and limited commercial use this approach appears very promising. This may result in higher levels of weed control through the use of less herbicides per acre. The details of the method are as follows:

Split (low rate) applications of the mixture of Betanal + Betanex at 0.47 - 0.7 litres per acre (1.16 - 1.73 litres of each per hectare) broadcast equivalent in 18 - 39 litres of water per acre (46 - 93 litres per hectare) may be applied to sugarbeets at any stage of growth when necessary to control early germinating, difficult to control weeds. The spray must be applied when the earliest emerging weeds have reached cotyledon size.

Any weeds which are not completely controlled by the first treatment will usually be checked and controlled by repeat applications. The following applications should be made 5-7 days after preceding application or when another flush of weeds germinates. If the second application is delayed, conventional treatment as described above will be necessary.

Apply the 2 - 3.5 litres per acre (5.26 - 8.77 litres/hectare) rates only to sugarbeets past the 2-true leaf stage.

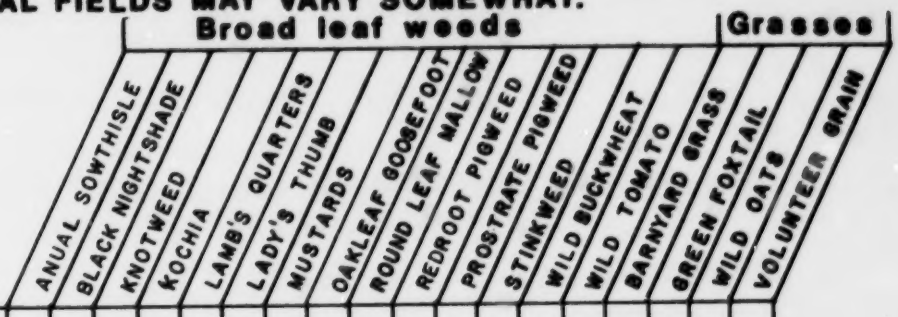
HERBICIDE RFSIDUES FROM PRECEDING CROPS

Sugarbeets may be injured if planted onto land that has been treated with the following herbicides: Atrazine, Glean, Treflan, Tordon, Sencor and Banvel, when used late in the preceding year.

AVERAGE WEED CONTROL OBTAINED IN EXPERIMENTS. ACTUAL RESULTS OBTAINED ON INDIVIDUAL FIELDS MAY VARY SOMEWHAT.

Control Ratings

- ● – EXCELLENT
- ◕ – VERY GOOD
- ◒ – GOOD
- ◔ – FAIR
- ○ – POOR
- – Insufficient info.



	ANUAL SOWTHISLE	BLACK NIGHTSHADE	KNOTWEED	KOCHIA	LAMB'S QUARTERS	LADY'S THUMB	MUSTARDS	OAKLEAF GOOSEFOOT	ROUND LEAF MALLOW	REDROOT PIGWEED	PROSTRATE PIGWEED	STINKWEED	WILD BUCKWHEAT	WILD TOMATO	BARNYARD GRASS	GREEN FOXTAIL	WILD OATS	VOLUNTEER GRAIN
FALL-LAYERED & RIDGED																		
AVADEX BW	○	○	○	○	○	○	○	○	○	○	○	○	◔	○	○	○	●	○
EPTAM				◒	◒					◔	◔	◒	◔			◒	◒	◒
NORTRON	●	◒	○	◒	◒		○		◒	◒		◒		◒	●	●	◒	●
NORTRON & RONEET	◔	●	○	◒	◒	◔		◒	●	◒			◔	●	◒	●	●	●
PYRAMIN	◒	◒	◒	○	◒	◒		◒	○	◔		○	◔	◒	○	◔	○	○
PYRAMIN & AVADEX BW	◒	◒	◒	○	◒	◒		◒	○	◔		○	◔	◒	○	◔	●	○
SPRING-PREPLANT, INCORPORATED																		
AVADEX BW	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○
NORTRON					◒		○		◒	◒	◔	○	◔		◒	◒	◒	◒
NORTRON & RONEET		◒	○		◒	◔	○		◒	◔		○	○	◒	◒	●	●	◒
PYRAMIN		●	●		◒	●				◒	●	●	●		○	○	○	○
PYRAMIN & AVADEX BW		●	●		◒	●				◒	●	●	●		○	○	●	○
RONEET		◒	○	○	◔	○			◔	◔	◔	○	○	◒	◔	◒	◔	◔
RONEET & AVADEX BW		◔		○	◔	○	○		◔	◔		○	○	◒	◔	◒	●	
SPRING-AFTER WEED EMERGENCE BUT BEFORE BEET EMERGENCE																		
GRAMOXONE	●	●	●	●	●	●	●	●	◕	●	●	●	●	●	●	●	◕	◔
POST-EMERGENT																		
BETANAL				◒	●			●	◕	◒		●		◒	○	◒	○	○
BETANEX					●				○	●		●			○	◒	○	○
BETANAL & BETANEX		◔	○	◔	●	◔	◒		○	◒		●	◔	◒	○	◒	○	○
CARBYNE	○	○	○	○	○	○	○	○	○	○	○	○	◒	○	○	○	●	○
DALAPON	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◒	◒	○	○
FUSILADE	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	●	●
HERBICIDE 273	○	○	○	○	○	●	○	○	○	○	○	○	◒	○	○	○	○	○
HOEGRASS	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	●	○
POAST	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	●	●
TCA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◒	○	○

AVADEX BW (triallate)

1. FORMULATION: Emulsifiable Concentrate: 400 g/L (22.7 L pail)
   Granular 10% (22.7 kg bags)

2. REGISTERED MIXES: Avadex BW + Liquid Fertilizers
   Avadex BW + Granular Urea Fertilizer
   Avadex BW + Ro-Neet

   Mix restrictions: Thorough and uniform mixing is required.
   Mixing with other pesticides: Not recommended.

3. WEEDS CONTROLLED: Wild Oats

4. WEEDS SUPPRESSED: None

5. WHEN USED:

   Spring - Pre-plant incorporated

   Fall - Since soil drifting may be encouraged by fall incorporation, this application technique is discouraged in those areas where soil drifting is a problem.

6. HOW TO APPLY:

With:	Aircraft (granules only) or ground equipment			
Rate:	Liquid		Granules	
	L/ac	(L/ha)	kg/ac	(kg/ha)
	1.71-2.22	(4.25-5.5)	7.1-9.1	(17.5-22.5)
Water Volume:	Liquid only - minimum of 100 L of water/ha			
Incorporation:	Time - Incorporate liquid immediately following application - Incorporate granules within 48 hours following application Implements - A double disc or light duty cultivator followed by harrows should be used for pre-plant incorporated treatments.			
Pressure:	Liquid only - 200 kPa			
Nozzles:	All fan type nozzles delivering 40 L/ac (100 L/ha)			
Protective Equipment:	Use standard protective clothing when applying the herbicide. - plus a respirator and goggles when opening bags. - plus face shield and apron when opening containers of the concentrated product.			

7. SPRAYING TIPS:

   (a) Equipment should be operated at 9 km/h.
   (b) Double discs and cultivators should be set to a depth of cut up to 7.5 cm in order to distribute the herbicide in the upper 5 cm of soil.

(c) The herbicide must be uniformly incorporated into the top 5 cm of soil.
(d) Incorporation under excessively moist soil which hinders thorough mixing of the soil is not recommended.
(e) Straw, lumps of soil, or other materials which are dragged by harrows will cause uneven incorporation resulting in reduced wild oat control.
(f) On stubble, incorporate with a double disc or cultivator implement followed at right angles by a harrow operation.
(g) On summerfallow or level plowed ground, two harrow operations at right angles may be adequate if the soil is loose and free of trash and lumps.
(h) Incorporation of the Avadex BW/urea combination is recommended as follows:
Spring - Two operations immediately following application at right angles to each other with a delay of 24 hours between incorporations. A vibra-shank or light duty field cultivator is the preferred incorporation implement.
Fall - Fall applications should be immediately followed by one shallow incorporation with a double disc or cultivator followed in the spring prior to seeding by a shallow cultivation at right angles to the fall operation.

8. HOW IT WORKS: Applied prior to germination, Avadex BW is absorbed by wild oat shoots, usually resulting in death before emerging through the soil surface. Occasionally (particularly under dry conditions), some wild oats may emerge and reach the 3 or 4 leaf stage before dying from their uptake of Avadex BW.

9. EXPECTED RESULTS:

Wild oats: The major effects of Avadex BW on wild oats are evident before they emerge through the soil surface. Scraping away the top 1.5-2.5 cm of soil 1 to 2 weeks following treatment and/or seeding will expose white to yellow colored wild oats shoots 2.0-2.5 cm in length with pinched tips. These shoots are essentially dead and will decay. Plants which have emerged and absorbed a lethal dose of Avadex BW will display a protrusion of the growing shoots through the lower stem of the wild oat plant. Under dry soil conditions, a timely rainfall of 1.5 cm or more when wild oats are emerging, can cause post-emergent die-back of a high percentage of wild oat plants on most soil types.

Conditions under which less than satisfactory results may be expected:
1. Incomplete incorporation due to wet, cloddy soil, or heavy trash.
2. Incorporation delayed.
3. Very dry soil conditions.
4. Disruption of the Avadex BW treated layer of soil, such as with the seed drilling operation, may leave seed drill ridges in which wild oats can emerge.
5. Equipment deficiencies such as too light harrows.

10. EFFECTS OF RAINFALL: Required for activation of Avadex BW by keeping the treatment layer in a moist condition. Rainfall immediately following application and before incorporation may result in reduced wild oat control due to loss of Avadex BW into the atmosphere.

11. MOVEMENT IN SOIL: Negligible.

12. GRAZING AND CROPPING RESTRICTIONS:

Drift: No effect on standing crops
Grazing Restrictions: None
Crop Use After Hail: No restrictions
Succeeding Crops: Oats should not be seeded into soil treated with Avadex BW in the previous year.

13. TOXICITY:

- has low acute mammalian toxicity
  oral LD_{50} rats = 1,675 to 2,165 mg/kg
  oral LD_{50} dogs = greater than 20 gm/kg
  Dermal LD_{50} rabbits = 2,225-4,050 mg/kg
- may cause slight eye irritation; not a skin sensitizer
- no short-term or long-term human health problems have been associated with Avadex
- slightly toxic to fish; non-toxic to birds

14. PRECAUTIONS AND FIRST AID: Avoid contact with skin and eyes, and do not inhale spray mist. Wear rubber gloves and goggles when spraying.

- If on skin, wash with soap and water.
- If in eyes, flush with water for 15 minutes. Get medical attention.
- If Avadex is swalled, do not induce vomiting because of petroleum distillates in the formulation. Get medical attention promptly.
- Take labelled container with you.

The emulsifiable concentrate (E.C.) of Avadex is combustible. Do not use, pour, spill or store near heat or open flame. In case of fire, use water, spray, foam or CO_2. In case of a spill, flush area with water spray.

15. STORAGE: Store above $0^{o}C$ to keep from freezing. Freezing will result in crystals which settle to the bottom of the can. If allowed to freeze, place in a warm room ($22^{o}C$ or higher) and roll and shake the can frequently for several days to re-dissolve.

16. WHERE AVAILABLE: Alberta Wheat Pool, Cargill Grain, Green Cross Product Dealers, United Grain Growers, Pfizer Chemical Dealers, Federated Co-operatives, Pioneer Grain.

Additional information available from:

Monsanto Canada Inc.
55 Murray Park Rd.
WINNIPEG, Manitoba
R3J 3E2
Phone: (204) 885-6740

In case of emergency involving a Monsanto herbicide call the following number collect at any time, phone 1-314-694-1000.

BETANAL (phenmedipham)

1. FORMULATION: E.C.
   Phenmedipham 150 grams/Litre
   Available in 19 litre pails

2. REGISTERED MIXES: BETANAL + BETANEX
   BETANAL + HERBICIDE 273
   BETANAL + BETANEX + HERBICIDE 273

3. CROPS:

4. WEEDS CONTROLLED: Lamb's-quarters, wild buckwheat, green foxtail, yellow foxtail, mustard, nightshade, kochia, goosefoot.

5. WHEN USED: Early post-emergence when weeds are cotyledonary to 4 leaves. Sugar beets should be past the two true leaf stage. Do not commence spray application until mid-afternoon.

6. HOW TO APPLY: By ground equipment as a band or broadcast treatment.

7. RATE: 2.22 to 4.45 litres/acres broadcast equivalent in a maximum of 28 litres of water for each litre of BETANAL. (5.5 to 11 litres/hectare broadcast equivalent in a maximum of 28 litres of water for each litre of Betanal).

8. MODE OF ACTION: Absorbed through leaves. Sharply inhibits rate of assimilation of CO_2 in treated plants within 6 hours. Resistant species (sugar beets) begin recovery in this time while susceptible species do not.

9. EXPECTED RESULTS:

   Under warm conditions, weed kill is complete in 4 to 7 days. Cool conditions require longer periods up to 2 weeks.

10. EFFECT OF RAINFALL:

    Rainfall within 6 hours of application may reduce weed kill.

11. TOXICITY:

    Acute oral toxicity - phenmedipham
    Rat) 8,000 mg/kg

    Acute oral toxicity - BETANAL
    Rat) 2,000 mg/kg

    Acute dermal toxicity - phenmedipham
    Rat) 4,000 mg/kg

    Acute dermal toxicity - BETANAL
    Rat) 20,000 mg/kg

    Toxic to fish - avoid contamination of water supply.

12. PRECAUTIONS AND FIRST AID:

Harmful if swallowed. May produce irritation of skin or eyes. Avoid breathing spray mist. Avoid contact with skin and eyes.

If swallowed, induce vomiting and/or administer gastric lavage. In case of skin contact, wash with soap and water. If in eyes, flush with water for at least 15 minutes and get medical attention.

13. STORAGE:

Store away from food or feed stuffs.

ADDITIONAL INFORMATION AVAILABLE FROM:

NOR-AM Chemical Company
Wilmington, Delaware

BETANEX (desmedipham)

1. FORMULATION: E.C.
   Desmedipham 150 grams/litre
   Available in 19 litre pails

2. REGISTERED MIXES: BETANEX + BETANAL
   BETANEX + HERBICIDE 273
   BETANEX + BETANAL + HERBICIDE 273

3. CROPS:

4. WEEDS CONTROLLED: Redroot pigweed, lamb's-quarters, mustard, ragweed, wild buckwheat, kochia, goosefoot, stinkweed.

5. WHEN USED: Early post emergence when weeds are cotylendonary to 4 leaves. Sugar beets should be past the two true leaf stage. Do not commence spray application until mid-afternoon.

6. HOW TO APPLY: By ground equipment as a band or broadcast treatment.

7. RATE: 2.22 to 3.84 litres/acre broadcast equivalent in 80 litres to 160 litres water per acre. (5.5 to 9.5 litres/hectare broadcast equivalent in 200 to 400 litres of water per hectare).

8. MODE OF ACTION:

   Absorbed through leaves. Sharply inhibits rate of assimilation of CO_2 in treated plants within 6 hours. Resistant species (sugar beets) begin recovery in this time while susceptible species do not.

9. EXPECTED RESULTS:

   Under warm conditions, weed kill is complete in 4 to 7 days. Cool conditions require longer periods up to 2 weeks.

10. EFFECT OF RAINFALL:

    Rainfall within 6 hours of application may reduce weed kill.

11. TOXICITY:

    Acute oral toxicity - desmedipham
    Rat) 10,250 mg/kg

    Acute oral toxicity - BETANEX
    Rat) 3,720 mg/kg

    Acute dermal toxicity - desmedipham
    Rabbit) 2,025 - 10,250 mg/kg

12. PRECAUTIONS AND FIRST AID:

Harmful if swallowed. May produce irritation of skin or eyes. Avoid breathing spray mist. Avoid contact with skin and eyes.

If swallowed, induce vomiting and/or administer gastric lavage. In case of skin contact, wash with soap and water. If in eyes, flush with water for at least 15 minutes and get medical attention.

13. STORAGE:

Store away from food or feed stuffs.

ADDITIONAL INFORMATION AVAILABLE FROM:

Nor-Am Chemical Company
Wilmington, Delaware

CARBYNE 2FC (barban)

1. FORMULATIONS: Emulsifiable concentrate 240 g/L
   Available in 19 L containers

2. REGISTERED MIXES: No registered mixes.

   Mixing with other pesticides - not recommended.

3. CROPS:

4. WEEDS CONTROLLED: Wild Oats

5. WEEDS SUPPRESSED: Wild Buckwheat

6. WHEN USED: When the majority of wild oats are in the 2 leaf stage and the wild buckwheat are in the cotyledon stage.
   May be sprayed at any time the wild oats are in the 2 leaf stage.

7. HOW TO APPLY:

With:	Aircraft or ground equipment
Rate:	Apply 0.8-1.4 L/acre (2-3.5 L/ha)
Water Volume:	Aircraft: Minimum 10-18 L/acre (25-45 L/ha) Ground Equipment: 18 L total spray volume/ac (45 L/ha)
Incorporation:	Not applicable
Pressure:	300 kPa (minimum)
Ground Speed:	6.5 km/h
Nozzles:	Tee Jet 650067, 730067, 800067 Monarch 20 and 22, Spray Jet 65.067 When wind velocity is 15-30 km/h use TK.75 or D.75 nozzles spaced at 100 cm on the boom.
Protective Equipment:	Standard protective clothing used when applying herbicides. - plus a face shield and apron when opening containers of concentrated liquid.

8. SPRAYING TIPS:

   (a) Always make sure the sprayer is thoroughly cleaned before spraying Carbyne.
   (b) Wild oat seedlings will produce a new leaf every five days (with good to average growing conditions). Therefore, they will reach the 2 leaf stage four to nine days after emergence.
   (c) Carbyne contains an optimum blend of surfactants and wetting agents. Therefore, additional wetting agents and surfactants are not required in the spray tank.
   (d) There are no restrictions on later application of other pesticides after the Carbyne treatment.
   (e) Carbyne should not be applied when plants are wet with dew or rain. Dew or rain 15 minutes after spray operations will not affect the activity of Carbyne.

(f) To achieve good wild oat control with Carbyne, it is essential that the wild oat plants receive good coverage from the spray application. The required coverage can be obtained by:

(g) Applying Carbyne in sufficient water to give 18 L total spray volume/ac (45 L/ha).

(h) Operating the sprayer at 300 kPa to ensure a good break-up of the spray into fine droplets.

(i) Rotating the spray booms to direct the spray down and forward at a 45° angle.

9. HOW IT WORKS: Carbyne is a partially systemic herbicide (some translocation in plant), which penetrates the leaf and stem surfaces of the wild oat plant and interferes with cell division in the plant. Further development of the young seed head and new leaves is stopped shortly after the 2 leaf wild oat plant is treated. The first symptoms of Carbyne action are a stoppage of new growth, followed by a change in the color and texture of the plant. The plant becomes brittle, the leaf tips turn brown and the plant eventually dies.

10. EXPECTED RESULTS:

Wild Oats: An immediate stoppage of new growth, with the existing leaves gradually turning a blue-green color 7-10 days after application. At the same time, a swelling of the stem at ground level may also be noted. The leaf tips will turn brown, the plant becomes brittle and eventually dies 3-4 weeks after treatment. The time required for these symptoms to appear and for the wild oat plant to die is affected by crop stand, growing conditions and soil fertility.

Conditions under which poor results may be expected:

1. Rain within 15 minutes of application.
2. Too low an application rate of Carbyne for existing conditions.
3. Inadequate spray coverage of the wild oat plant due to lower than recommended sprayer pressure, incorrect spray nozzles or improper sprayer calibration.
4. Improper timing of Carbyne application relative to the growth stage of the wild oat plants. Only the wild oat plants in the 2 leaf stage will be controlled.

11. EFFECTS OF RAINFALL: Rainfall within 15 minutes of application may decrease control.

12. MOVEMENT IN THE SOIL: Not applicable

13. GRAZING AND CROPPING RESTRICTIONS:

Drift: The hazard from drift is low, only common oats, buckwheat and rye can be seriously affected by drift.
Grazing Restrictions: Do not graze or feed crop for 5 weeks after treatment.

Crop Use After Hail: Do not use crop for 5 weeks after treatment.
Succeeding Crops: No restrictions.

14. TOXICITY:

- has very low acute toxicity to mammals
  oral LD_{50} rats = 1,350 mg/kg (active ingredient)
  Oral LD_{50} rats = 2,750 mg/kg (formulation)
- has very low dermal toxicity
  dermal LD_{50} rats = 2,300 mg/kg (active)
  dermal LD_{50} rats = 3,360 mg/kg (formulation)
- short term poisonings have not been observed
- long term exposure to this product has sensitized some people to it
- very toxic to fish

15. PRECAUTIONS AND FIRST AID: Avoid as much exposure to Carbyne as possible.

- If on skin, wash off with soap and water.
- If in eyes, flush for 15 minutes with clean water and get medical attention.
- If Carbyne is swallowed, do not induce vomiting. Get medical attention.
- Take the labelled container to doctor.

16. STORAGE: At -40°C Carbyne thickens but does not freeze. The viscosity will return to normal as the temperature is increased. The good cold weather properties allow Carbyne to be stored in unheated storage.

17. WHERE AVAILABLE: Alberta Wheat Pool, Federated Co-operatives, Green Cross Product Dealers, Oliver Agricultural Supply, Pioneer Grain and United Grain Growers.

Additional information available from:

Velsicol Canada Inc.
1360 Blundell Road
MISSISSAUGA, Ontario
L4Y 1M5
Phone: (416) 270-5112

DOWPON M GRASS KILLER (dalapon)

1. FORMULATIONS: Free flowing wettable powder
   Dalapon ... 74% active
   Available in 25 kg bags

2. REGISTERED MIXES: Mixing with other pesticides: Not recommended

3. CROPS: Sugarbeets

4. WEEDS CONTROLLED: Barnyard grass, blue grass, green foxtail (seedling), quackgrass, reeds, cattails.

5. WEED SUPPRESSED: None

6. WHEN USED:

   Sugarbeets - when beets are in 2-4 leaf stage and grass in seedling to 3 leaf stage.

7. HOW TO APPLY:

With:	Ground equipment
Rate:	0.34-0.57 kg/acre (0.85-1.4 kg/ha)
Water Volume:	Use minimum of 40 L of water/ac (100 L/ha)
Incorporation:	Not applicable
Pressure	275 kPa
Ground Speed:	9 km/h
Nozzles:	All standard and low pressure nozzles, delivering 40 L/ac (100 L/ha) or more.
Protective Equipment:	Standard protective clothing when applying herbicides. - plus a respirator and goggles when opening Dowpon bags.

8. SPRAYING TIPS: Do not make more than one treatment per year. Should be uniform and provide complete coverage of target weeds.

9. HOW IT WORKS: Dalapon is absorbed by both roots and leaves and is easily washed off foliage. It translocates readily throughout the plant and accumulates in young tissue. It affects cell membrane permeability.

10. EXPECTED RESULTS: Several weeks may be required for maximum effect on top growth in heavy stands. Because of limited persistence in the soil, new seedling grasses may invade treated area. If grass is not growing well, i.e. overly mature or suffering from drought or cold weather, results may be poor.

11. EFFECTS OF RAINFALL: Under dry conditions, decomposition may be slower, and more time will be required after ploughing before certain crops can be planted. Rain shortly after application can wash the herbicide off the leaves.

12. MOVEMENT IN SOIL: Not a problem under normal use conditions.

13. GRAZING AND CROPPING RESTRICTIONS: Do not allow dairy or meat animals to graze on treated vegetation during the year of application. On land to be planted to sensitive crops, including grasses, delay planting for at least 30 days after ploughing or deep cultivation, following application.

14. TOXICITY:

- has very low acute mammalian toxicity
  oral LD_{50} rats = 9,300 mg/kg
- no short term or long term human health problems have been associated with Dowpon M when used according to label
- non-toxic to fish and birds
- moderate skin irritant on repeated prolonged contact

15. PRECAUTIONS AND FIRST AID: This product may cause a mild burn if it is kept in contact with the skin. Therefore, wash skin immediately with plenty of water. This product can cause eye irritation. Avoid inhaling dust which may be irritating to the throat and air passages.

- If in eyes, flush with plenty of water for 15 minutes. Get medical attention.

16. STORAGE: Store away from food and feed stuffs.

17. WHERE AVAILABLE: Oliver Agricultural Supply, Cargill Grain, Federated Co-operatives.

Additional information available from:

Dow Chemical Canada Inc.
Suite 2412, 10025 Jasper Avenue
EDMONTON, Alberta
T5J 1S6
Phone: 1-800-661-6436 (TOLL FREE)

GRAMOXONE (paraquat)

1. FORMULATIONS: Water soluble solution 200 g/L
   Available in 1 and 5 L containers

2. REGISTERED MIXES: None applicable to Alberta

   Mix restrictions: Not applicable
   Mixing with other pesticides: Not recommended

3. CROPS: Stale seedbed for sugarbeets

4. WEEDS CONTROLLED: The herbicidal effect varies with weed species, hence repeat applications may be necessary on certain perennial weeds. Annual weeds are generally killed with one application if the weed growth has been completely covered with the spray solution.

5. WEEDS SUPPRESSED: Most perennial weeds.

6. WHEN USED: Prior to the emergence of the crop, but after weeds emerge. For best results use Gramoxone at an early stage of the weed's development.

7. HOW TO APPLY:

With:	Ground equipment only.
Rate:	Weed Control with stale seedbed technique. Post emergent to weeds. Prepare a seedbed at least 2-4 weeks before seeding to stimulate weed growth. Seed without further cultivation and with a minimum disturbance of the soil. To burn off emerged weeds apply 1.11-2.22 L Gramoxone in 445 litres of water/acre prior to or after seeding. (2.75 - 5.5 L in 1000 L of water per ha). Do not apply later than 3 days before crop emergence. Use 2.22 L/ac (5.5 L/ha) when weeds are above 5 cm in height, and higher volume of water on dense weed growth.
Water Volume:	Given in above section. Thoroughly wet all foliage. For dense weed growth use the higher volume of water.
Incorporation:	Not applicable.
Pressure:	300 kPa
Ground Speed:	9 km/h
Nozzles:	All standard nozzles delivering the correct volume.
Protective Equipment:	Standard protective clothing used when applying herbicides. - plus a face shield and apron when opening containers or liquid concentrate.

8. SPRAYING TIPS:

(a) Use high volume, low pressure type spraying equipment to apply the appropriate number of L/ha. Foliage must be thoroughly covered to obtain good results.
(b) Applications made on cloudy days, during dull sunlight or just prior to or during periods of darkness will generally increase the subsequent effectiveness of the treatment.
(c) Do not apply with mist blowers.
(d) It is important to thoroughly wash equipment after spraying - use a wetting agent (Agral 90 at 60 mL/100 L of water), flush and spray out, then thoroughly rinse with clean water. When possible, the equipment should be filled with clean water and left overnight. Spray out before storing equipment or using other materials.

9. HOW IT WORKS: Gramoxone is absorbed by all leaf and stem surfaces, but it does not move in the plant. Once inside the plant, Gramoxone interferes with the photosynthetic process of the plant. This is followed by yellowing and eventual death of the plant.

10. EXPECTED RESULTS:

Weeds: Gramoxone provides immediate, fast and virtually complete annual weed kill with only one application in most cases. Repeat applications may be necessary when dealing with perennial weeds. Usually yellowing will occur within a few hours of application. Desiccation of the plant proceeds rapidly.

Crop: Gramoxone is inactivated on contact with the soil, therefore it has no residual effect in the soil.

Conditions under which poor results may be expected:
1. Rain prior to the spray solution drying on the plant.
2. Use clean (non-turbid) water for spraying Gramoxone. Muddy water will reduce the effectiveness of the chemical.
3. Inadequate coverage of green foliage.

11. EFFECTS OF RAINFALL: Once the spray solution has dried on the plant tissue, rain will not reduce the effectiveness of Gramoxone.

12. MOVEMENT IN SOIL: Gramoxone binds to the soil and becomes biologically unavailable.

13. GRAZING AND CROPPING RESTRICTIONS:

Drift: Avoid application or drift onto crops, ornamental plants, lawns, grazing areas or other desirable growth.
Grazing Restrictions: Not applicable.
Crop Use After Hail: No restriction
Succeeding Crops: No restriction

14. TOXICITY:

- has very high acute mammalian toxicity
  oral LD_{50} rats = 120 mg/kg
  dermal LD_{50} rabbits = 480 mg/kg
- symptons of acute poisoning may occur
- long-term inhalation exposure to Gramoxone may cause lung damage
- delays healing of open wounds.

15. PRECAUTIONS AND FIRST AID: Do not inhale Gramoxone spray mist. Therefore, avoid spraying on windy days. Use of a respirator while spraying, is recommended.

- If on skin, wash with soap and water immediately.
- If in eyes, flush with water for 15 minutes and get medical attention immediately.
- If swallowed, induce vomiting. Give plenty of milk or water to drink. Get medical attention.
- Take labelled container with you to doctor.
- Take the information on Gramoxone in this booklet with you to doctor.

FOR PHYSICIAN: If swallowed, give stomach wash-out and test urine and gastric aspirate for paraquat. If positive, give up to 1 L of adsorbent suspension (30% Fuller's Earth, activated charcoal or amberlite resin) mixed with a purgative ($MgSO_4$, NA_2SO_4 or mannitol). Repeat administration of adsorbent suspension for the next 24 hours, plus purgative as required. Maintain and monitor electrolyte and fluid status daily. Consider haemodialysis or haemoperfusion using charcoal column. Delay oxygen as long as possible. If in eyes, treat symptomatically, using antibiotics and steriods as necessary. Emergency telephone numbers (416) 643-4123, 8:00 am - 4:45 pm. After hours (416) 528-6771 (state as calling for Chipman).

16. STORAGE: Gramoxone will crystallize if subjected to freezing temperatures. It therefore requires heated storage.

17. WHERE AVAILABLE: From major grain companies and many independent farm supply dealers.

Addition information available from:

Chipman Inc.
P.O. Box 965,
Winnipeg, Manitoba
R3C 2V5
Phone (204) 772-0434

PRACTICAL USE CONSIDERATIONS

1. Handle this product with extreme care.
2. Do not spray on a windy day.

FUSILADE (fluazifop-butyl)

1. Formulation: emulsifiable concentrate 250 g/l
   (FUSILADE 250 EC) available in 8L containers.

2. Registered Mixes: none applicable to sugar beets.

3. Crops: Sugarbeets.

4. Weeds Controlled:

volunteer corn	wild oats
colunteer barley	foxtail (green & yellow)
volunteer wheat	barnyard grass
volunteer oats	wild proso millet

5. Weeds suppressed: quackgrass.

6. When used: Fusilade is applied to actively growing annual grasses (except green & yellow foxtail) at the full 2 - 6 leaf stages. For green & yellow foxtail apply at the full 2-4 leaf stages. Apply Fusilade at the 3-5 leaf stage for season long control of quackgrass.

7. How To Apply:

   With: ground equipment equipped with standard flat fan nozzles is recommended.

   RATE:

Grass species controlled	litres of product per acre	litres of product per hectare
volunteer corn	0.24	0.6
barnyard grass	0.32	0.8
volunteer cereals	0.32	0.8
Wild oats	0.40	1.0
wild proso millet	0.40	1.0
foxtail (green, yellow)	0.40	1.0 suppression
	0.57	1.4 control
quackgrass (tilled land)	0.81	2.0
quackgrass (non-tilled land)	1.21 - 1.62	3.0 - 4.0

   Water volume: 40 - 121 litres/acre (100 - 300 L/hectare), when band spraying use a proportionately smaller spray volume per hectare.

   Pressure: 200 - 300 kPa

   Nozzles: All standard and low pressure nozzles delivering the required water volume.

Protective equipment: Standard protective clothing used when applying herbicides plus wear a face shield and rubber gloves when opening containers and handling concentrate.

8. Spraying Tips: Agral 90 must be added at 0.1% of total spray volume.

9. How it works: Fusilade is a systemic herbicide which is translocated from the treated foliage to the growing points of leaves, shoots, roots or rhizomes. Although the growth of grasses ceases soon after application, the process of killing the foliage, rhizomes and the entire plant may take several weeks. Color changes later.

10. EXPECTED RESULTS: Fusilade will be less effective when weeds are stressed by lack of moisture, low-temperature and/or very low relative humidity. Control is effected earlier on plants which are actively growing. Quackgrass can be expected to be controlled for the growing season with regrowth of quack occurring in the fall of the year. Rhizomes of quackgrass must be disturbed as in normal cultivation practises prior to the application of FUSILADE to obtain effective control at the lower rate. Tillage required to disturb rhizomes can be done in the spring before seeding. Quackgrass in direct drilled crops will be controlled at the higher label rates. Do not cultivate for 5 days after applying FUSILADE.

11. EFFECTS OF RAINFALL: Do not apply Fusilade if rainfall is expected within 2 hours of application as it may reduce the expected weed control.

12. MOVEMENT IN SOIL: FUSILADE has a minor soil activity component, but it is quickly metabolized by soil organisms and has no effect on emerging grasses.

13. Grazing and cropping restrictions:

Drift: Avoid application or drift onto susceptible cereal crops, lawns, grazing areas or other desirable growth.

Grazing restrictions: not applicable

Crop Use After Hail: no restriction

Succeeding Crops: no restrictions

14. Toxicity:
- has very low acute toxicity to mammals oral LD_{50} rat 3000 mg/kg
- no short-term or long-term human health problems have been associated with this product.
- relatively low toxicity to birds and relatively high toxicity to fish.

15. Precautions and first aid: Harmful if swallowed. May cause eye and skin irritation; wear an eye shield and rubber gloves when handling the concentrate. Avoid spray mist by staying upwind from the spray and/or by wearing a suitable mask or respirator. Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before re-use.

If swallowing, do not induce vomiting as this product contains a petroleum distallate, call a physician immediately. If in eyes, immediately flush with plenty of water for at least 15 minutes. Get medical attention. If on skin, wash with soap and water. If irritation developes and persists get medical attention. Consult your local poison control center for additional information.

16. Storage: Do not store at temperatures below 0^0C

17. Where available:

additional information available from

Chipman Inc.
P.O. Box 965
Winnipeg, Manitoba.
R3C 2V5

Phone (204) 772-0434 or TOLL FREE 1 - 800 - 665-4857

HERBICIDE 273 (endothall)

1. FORMULATIONS: Herbicide 273 is a 360 g/L liquid available in 18.2 litre containers.

2. REGISTERED MIXES: Betanal
Betanex

3. CROPS:

4. WEEDS CONTROLLED: lady's thumb, wild buckwheat, redroot pigweed, green foxtail and barnyard grass.

   - the addition of Betanal adds smartweed, knotweed, lamb's-quarters, ragweed, shepherd's purse and nightshade to the list.
   - the addition of Betanex adds smartweed, lamb's-quarters, ragweed and shepherd's purse.

5. WEEDS SUPPRESSED: none

6. WHEN USED: Post-emergence; 4-6 leaf stage of the crop.

7. HOW TO APPLY:

With: ground equipment

Rate: a) Band treatment (56 cm row spacing)

Band Width (cm)	Litres/ac	Litres/ha
15	0.40-0.51	1.0-1.25
20	0.40-0.71	1.0-1.75
25	0.61-0.81	1.5-2.0

- Use lower rate on light, sandy soils.

b) Broadcast Treatment - 0.91 to 1.92 L/ac in 36-110 L of water (2.25 to 4.75 L/ha in 90-275 L of water).

c) Tank Mixes (post emergence only, 56 cm row spacing)

	Broadcast (L/ac)	Band Width (cm)	Litres/ac	Litres/ha
Herbicide 273	0.6-1.32	15	0.10-0.30	0.25-0.75
		20	0.20-0.40	0.5 -1.0
		25	0.20-0.61	0.5 -1.5
Betanal	2.83	15	0.81	2.0
		20	1.11	2.75
		25	1.31	3.25
Betanex	2.83	15	0.81	2.0
		20	1.11	2.75
		25	1.81	3.25

Protective Equipment: Wear goggles, rubber gloves, rubber boots, overalls, rubber apron and respirator when handling.

8. SPRAYING TIPS:

a) As a post-emergence treatment, do not apply later than 40 days after emergence.

b) Some temporary marginal leaf burn may occur under adverse conditions but recovery is normally rapid.

c) For best results apply when average temperature is above 20°C.

d) Fill spray tank half full with water. With agitator operating, add Herbicide 273 followed by the other registered herbicides (tank mix) and the remaining water.

e) Mix only the amount of spray that will be used immediately.

f) Do not add any wetting agents or other spray adjuvants.

g) Avoid contact with or drift to either crop or plants as injury may result.

9. EFFECT OF RAINFALL: No information available.

10. GRAZING AND CROPPING RESTRICTIONS: Will not interfere with normal crop rotation.
Grazing Restrictions: no information available.

11. TOXICITY: Acute oral LD_{50} (rat) 125 mg/kg
Acute dermal LD_{50} (rabbit) 10,000 mg/kg

12. SAFETY AND PRECAUTIONS:

Symptoms of Poisoning: No symptoms of poisoning have been reported in man from the ingestion of endothall. Endothall is a severe eye and skin irritant. If inhaled, it may cause slight to moderate lung congestion and hemorrhage.

First Aid: In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. If swallowed, do not cause vomiting; give cold milk or cold water. Call a doctor immediately.

Protective Equipment: Wear goggles, rubber gloves, rubber boots, overalls, rubber apron and respirator when handling.

13. STORAGE:

Keep from freezing. Do not store with or near seeds, feed or foodstuffs.

14. WHERE AVAILABLE: Green Cross Dealers

Additional information available from:

Green Cross Products
820 - 26 Street N.E.
CALGARY, Alberta
T2A 2M4
Phone: (403) 273-5656

HOE-GRASS (diclofop-methyl)

1. FORMULATIONS: Emulsifiable concentrate containing 190 g/L (present as methyl ester).
   Available in 20 L containers.

2. REGISTERED MIXES:

   Mixing with other pesticides: Not recommended.

3. WEEDS CONTROLLED: Wild oats, yellow and green foxtail, barnyard grass, persian darnel and volunteer corn.

4. WEEDS SUPPRESSED: None

5. WHEN USED: 1-4 leaf stage of wild oats, green and yellow foxtail, barnyard grass. 1-3 leaf stage of persian darnel and a height of 15-25 cm for volunteer corn.

6. HOW TO APPLY:

With:	Ground or aircraft equipment
Rate:	1.5 L/acre (3.75 L/ha). One 20 L pail treats 13 acres at the 1.5 L/ac rate (5.33 ha at the 3.75 L/ha rate.
Water Volume:	Aircraft - minimum of 14 L/ac (35 L/ha) Ground - 40 L/ac (100 L/ha)
Incorporation:	Not applicable
Pressure:	Aircraft - 300 kPa, ground - 275 kPa
Ground Speed:	9 km/h
Nozzles:	Ground - use of 80° stainless steel flat fan nozzles is recommended for optimum spray coverage. Do not use flood jet nozzles. When band spraying TZ3 and TZ6 or narrow angle flat fan nozzles may be used.
Protective Equipment:	Standard protective clothing used when applying herbicides. - plus a face shield and apron when opening containers of concentrated liquid.

7. SPRAYING TIPS:

   (a) Nozzles should be tilted 45° forward to ensure better coverage.
   (b) During periods of stress (for example very hot 28°C and/or dry conditions, or very low humidity), plants are not actively growing. Application of Hoe-Grass during these periods may result in significantly reduced weed control.
   (c) Do not mix Hoe-Grass with any other herbicides, insecticides, fungicides, fertilizers or any other chemicals or additives.

7. SPRAYING TIPS: (continued)

(d) Hoe-Grass must be applied before the use of any broadleaf herbicide. A time interval of 4 days after application of Hoe-Grass is required to eliminate a reduction of grassy weed control.

(e) Do not use C.D.A. (Controlled Droplet Application) equipment as a reduction in grassy weed control will result.

8. HOW IT WORKS: Hoe-Grass possesses contact as well as systemic action. Uptake is primarily through the leaves. Penetration and uptake via roots is also possible, providing the soil is sufficiently moist and the rate of application is relatively high. The site of Hoe-Grass action is the growing point and thus the herbicide should be applied near this point by directing the spray 45^{o} forward.

9. EXPECTED RESULTS: Yellowing of susceptible plants becomes noticeable within 2-4 days after application. New leaf growth exhibits lighter yellow blotches (chlorosis). The chlorosis deepens and browning develops within 10-14 days after application. At this point, photosynthesis and growth are inhibited and uptake of water and nutrients ceases.

Lack of adequate crown development is one of the most distinguishable features of diclofop-methyl activity, and is evident on the wild oats as well as in some barley varieties, for which Hoe-Grass is not recommended.

Sugarbeets may exhibit some leaf distortion for several days after application of Hoe-Grass. This effect on the leaves has not resulted in any yield reductions.

Conditions under which poor results may be expected:
1. Rain within one hour of application.
2. Low rate of Hoe-Grass.
3. Plants are under stress conditions.
4. Use of raindrop or flood-jet nozzles.
5. Tank mixes with insecticides, fertilizers or herbicides will reduce and possible damage the sugarbeets.

CAUTION: Application of Hoe-Grass MUST take place before tillering (stooling) of the grassy weeds. Poor weed control will result if application is made past tillering.

CAUTION: Good spray coverage is essential for optimum weed control especially in areas of heavy grassy weed populations.

10. EFFECTS OF RAINFALL: Rainfall within one hour will decrease activity.

11. MOVEMENT IN SOIL: Some movement in soil if sufficient moisture is present.

12. GRAZING AND CROPPING RESTRICTIONS:

Drift: Danger from drift is low since only oats and corn are susceptible crops. Shelterbelts and gardens should not be damaged although direct contact should be avoided.
Grazing restrictions: Do not graze treated green crop.
Succeeding Crops: No restriction.

13. TOXICITY:

- has very low acute toxicity to mammals
  oral LD_{50} rats = 2,140 mg/kg
  dermal LD_{50} rats = 5,000 mg/kg
- no short-term or long-term health problems have been associated with this product.
- toxic to fish; non-toxic to birds

14. PRECAUTIONS AND FIRST AID: Avoid contact with skin and eyes, and do not inhale spray mist.

- If on skin, wash off with soap and water.
- If in eyes, flush for 15 minutes with clean water and seek medical attention.
- If swallowed, do not induce vomiting but rush person to nearest hospital.
- Take labelled container with you.

15. STORAGE: Do not store below freezing. If stored for one year or longer, shake well before using.

16. WHERE AVAILABLE: Pioneer Grain, Alberta Wheat Pool, Federated Co-operatives, United Grain Growers and Cargill Grain.

Additional information available from:

Hoechst Canada Inc.
109, 2915 - 21 St. N.E.,
Calgary, Alberta
T2E 6Z1
Phone: (403) 230-2294

PRACTICAL USE CONSIDERATIONS

1. Mixtures of Hoe-Grass and either Betanal or Betanex will reduce weed control and significantly increase beet injury.

NORTRON E.C. (ethofumesate)

1. FORMULATIONS: Emulsifiable concentrate containing 180 grams/litre minimum ethofumesate.
   Available in 20 L containers.

2. TANK MIXES: NORTRON + Ro-Neet*
   NORTRON + T.C.A.*

3. CROPS: Sugar Beets.

4. WEEDS CONTROLLED: lady's thumb, lamb's quarter, purslane, redroot pigweed, shepherd's purse, Pennsylvania smartweed, crabgrass, barnyard grass, wild oats, volunteer wheat, kochia, foxtail, volunteer barley and oats.

5. WEEDS SUPPRESSED: Wild buckwheat, russian thistle, black nightshade.

6. WHEN USED: Nortron may be fall-layered or spring-applied before planting. Post-emergence applications are pending registration in Canada.

7. HOW TO APPLY: Via ground equipment.
   - Rate: Dependent upon soil type - 3.44 L - 8.90 L per acre (8.5 L - 22 L per hectare) broadcast 1.11 - 3.04 L per acre (2.75 L - 7.5 L per hectare) applied on an 18 cm band/55 cm row.
     Refer to label for tank-mix rates of application.
   - Water Volume: 44 - 222 litres per acre (110-550 litres per hectare).
   - Incorporation: Apply Nortron before or at planting time and incorporate into the soil to a depth of 2.5 to 5.0 cm. Deeper incorporation may reduce effectiveness. In areas of adequate rainfall, Nortron may be applied pre-emergence at the time of planting or shortly after, but prior to weed emergence.
     Incorporation Equipment: Test results have shown hooded-power or ground-driven rotary tillers, rolling cultivators, and harrows to be effective for incorporating Nortron into the soil. Do not apply Nortron through soil injector shanks.
   - Pressure: Apply Nortron to the soil using standard low pressure (150-350 kPA) spray equipment).
   - Nozzles: Do not use smaller than 50 mesh strainer nor less than an 8002F nozzle orifice.
   - Protective Equipment: Standard protective clothing used when applying herbicides. A protective apron and face shield is recommended when opening containers.

* registered trademark

8. SPRAYING TIPS:
   A. Large clods can reduce the effectiveness of Nortron. All existing vegetative growth should be thoroughly worked into the soil before treatment.
   B. Do not allow spray mixture to stand in tank overnight.
   C. Do not use Nortron in water having a temperature below 5°C. as crystallization of spray mixture may occur in the nozzles and strainers.
   D. Do not mix Nortron with fertilizers, insecticides, fungicides, or herbicides except Ro-Neet or T.C.A. Refer to label.

9. HOW IT WORKS: Uptake of ethofumesate occurs primarily via the emerging shoot as it passes upwards through treated soil; however, for certain broadleaf species, root uptake is more important. Ethofumesate is non-volatile and in all cases uptake occurs from aqueous solution.

10. EXPECTED RESULTS: Nortron, applied pre-plant incorporated, with proper activation, will normally not permit weed emergence. If emergence should occur, uptake has occurred, seedling will show loss of vigor and eventual death.

11. EFFECTS OF RAINFALL: Normally 1.5 cm of rainfall is sufficient to activate Nortron. In areas where moisture can be marginal, incorporation is recommended.

12. MOVEMENT IN SOIL: The depth to which ethofumesate is leached is dependent on soil texture, total amount of rainfall or irrigation, and the length of time from application. Under normal conditions, ethofumesate is only slowly leached from the soil surface, and most of the material remains concentrated in the upper 15 cm.

13. GRAZING AND CROPPING RESTRICTIONS:
   A. Where Nortron is used in combination with TCA, do not use treated sugar beet tops for feed or forage.
   B. Do not rotate with any crops other than sugar beets for 12 months after application. Thorough tillage, including moldboard plowing, should precede the planting of crops other than sugar beets. Do not use Nortron on muck or peat soils.

      If crop is lost due to climatic or soil conditions following application of Nortron do not plant crops other than sugar beets in Nortron-treated land during the same season. If fields are replanted to sugar beets, reseed into treated band. Do not retreat field with Nortron.

      To reduce injury to rotational crops following a droughty sugar beet season, Nortron should be applied only in a band, and field should be moldboard plowed after harvest.

      Wheat and barley may be injured if planted following a droughty sugar beet year.

14. TOXICITY:

E.C. formulation:	Acute oral LD_{50} (rat):	5560 mg/kg
	Acute dermal LC_{50} (rat):	>4000 mg/kg
Technical material:	Acute oral LD_{50} (rat):	>6400 mg/kg
	Acute oral LD_{50} (bobwhite quail):	>8343 mg/kg
	Acute dermal LD_{50} (rat):	>1440 mg/kg
	Dietary LC_{50} (mallard duck):	>10,000 mg/kg
	Toxic to fish	

15. PRECAUTIONS AND FIRST AID: Danger: Eye irritant. Causes eye or skin irritation. Do not get in eyes, on skin, or on clothing. Harmful if swallowed. AVOID INHALATION OF FUMES.

First Aid: In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. For eyes, call a physician. Remove and wash contaminated clothing before reuse.

This product contains petroleum distillates. If swallowed, drink promptly a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol. DO NOT INDUCE VOMITING. Call a doctor immediately. If patient is unconscious, give him air.

Environmental Hazards: Keep out of lakes, ponds, or streams. Do not contaminate water by cleaning of equipment or disposal of wastes.

16. STORAGE: Do not use or store near heat or open flame. Do not store near foods, feeds, or fertilizers. Avoid contamination of food. Store NORTRON in a cool place, above 0°C.

17. WHERE AVAILABLE:

Van Waters & Rogers Ltd.
Oliver Ind. Supply Ltd.
Federated Cooperatives Ltd.
Pfizer C & G Inc.

ADDITIONAL INFORMATION AVAILABLE FROM:

NOR-AM Chemical Company
P. O. Box 2867
Wilmington, DE 19805
1 (302) 995-1177
ATTN: H. Broughton Smith

Information contained herein is not intended as a substitute for product labeling. Refer to label on container prior to use.

POAST (sethoxydim)

1. FORMULATIONS: Liquid, emulsifiable containing 184 g/L active ingredient.
   Available in 7 L containers.

2. REGISTERED MIXES: Assist Oil Concentrate must be added to all applications of Poast.

3. CROP: Sugarbeets

4. WEEDS CONTROLLED: Annual grasses (wild oats, foxtails, volunteer cereals and other grasses).

5. WEEDS SUPPRESSED: Not applicable

6. WHEN USED: Post-emergence

7. HOW TO APPLY:

With:	Ground equipment or by air
Rate:	0.32-0.77 L/acre (0.8-1.9 L/ha)
Water Volume:	20-60 L/acre (50-150 L/ha) except for very dense weed infestations or to dense crop canopies 60-100 L/acre (150-250 L/ha)
Incorporation:	Not applicable
Pressure:	275-425 kPa
Ground Speed:	9 km/h
Nozzles:	Use of 80° stainless steel flat fan nozzles is recommended for optimum spray coverage. When band spraying, use narrow angle flat fan nozzles, or hollow cone nozzles such as TZ6.
Protective Equipment:	The use of protective eye equipment and standard protective clothing used when applying herbicides, is recommended.

8. SPRAYING TIPS: Tilt nozzles forward 45° to ensure better coverage. Treat when weedy grasses are at 2-5 leaf stage, actively growing, there is good soil moisture and the crop is small enough to permit thorough spray coverage.

Grass Species Controlled	Optimum Size Leaf Stage	Grass Plant Height	Product Rate
Green and yellow foxtail, barnyard grass, proso millet, fall panicum, witch grass, persian darnell.	2-5	10-15 cm	0.32 L/ac (0.8 L/ha)
	For extremely heavy infestations		0.40 L/ac (1.0 L/ha)
Above weeds plus wild oats	2-5	10-15 cm	0.57 L/ac (1.4 L/ha)
	For extremely heavy infestations		0.65 L/ac (1.6 L/ha)

Grass Species Controlled	Optimum Size Leaf Stage	Grass Plant Height	Product Rate
Above weeds plus volunteer wheat and volunteer oats	2-5	10-15 cm	0.65 L/ac (1.6 L/ha)
Above weeds plus volunteer barley	2-5	10-15 cm	0.77 L/ac (1.9 L/ha)

Assist Oil Concentrate must be added to all applications of Poast.

Required Water Volume		Required Amount of Assist	
Per Acre	Per Hectare	Per Acre	Per Hectare
20-60 L	(50-150 L)	0.30-0.40 L	(0.75-1.0 L)
60-100 L	(150-250 L)	0.81 L	(2 L)

Mixing Instructions:

Half fill clean spray tank with clean water.
Start agitator.
Add correct amount of Poast.
Add Assist Oil concentrate.
Agitate for 2-3 minutes.
Fill tank with water.
After any break in spraying operations, agitate thoroughly before beginning to spray.
Avoid allowing any spray to sit overnight.
Thoroughly clean the sprayer after use by flushing with water and detergent.

9. HOW IT WORKS: Poast is a contact and a systemic herbicide. Uptake into the plant is primarily through the leaves. Thorough coverage of the foliage is important for consistent grass control.

10. EXPECTED RESULTS: Susceptible grasses that were actively growing prior to treatment, stop growing and undergo a slow burn-back and colour change to first yellowish, then a purplish and finally a brown colour. The time required for complete control is normally 7 to 21 days following treatment, depending on growing conditions and crop competition. Conditions under which poor results may be expected:

1. When grasses are stressed due to drought, flooding or prolonged cool temperatures (15°C or less), control can be reduced or delayed since grasses are not actively growing. Grass escapes or re-tillering may occur under prolonged stress conditions. DO NOT MAKE APPLICATIONS TO GRASSES STRESSED LONGER THAN 20 DAYS, DUE TO LACK OF MOISTURE AS UNSATISFACTORY CONTROL CAN RESULT. Thorough pre-plant tillage operations are required to fields where sod or forage grass crops may have grown the previous year.

2. Do not mix or apply Poast with any other additive, pesticide or with fertilizer except as specifically recommended on this label.

11. EFFECTS OF RAINFALL: Rainfall within one hour of application may reduce the effectiveness of the spray.

12. MOVEMENT IN SOIL:

13. GRAZING AND CROPPING RESTRICTIONS:

Drift: Injury to grass (forages), cereal or corn crops and turf may occur if Poast is applied on or too clost to these susceptible crops. Do not apply when weather conditions may cause spray drift from treated fields to adjacent crops. Wash sprayer thoroughly after use to avoid damage to the next crop sprayed, especially if it is a cereal, forage or corn crop.

Grazing Restrictions: Do not graze treated fields or harvest for feed prior to crop maturity.

Succeeding Crops: No restriction.

14. TOXICITY:

- has very low acute mammalian toxicity

Technical Material

oral LD_{50} rats = 2,676 mg/kg
oral LD_{50} mice = 5,600 mg/kg
dermal LD_{50} rats = greater than 5,000 mg/kg
dermal LD_{50} mice = greater than 5,000 mg/kg

- low toxicity to birds, fish and bees (sethoxydin)
- hazards to the environment are low because of rapid breakdown in soil.

Formulated Material

oral LD_{50} rats = 2,500 mg/kg
dermal LD_{50} rats = 4,000 mg/kg
4-hour inhalation LD_{50} = 700 mg/m^3 air

- causes moderate skin and eye irritation

15. PRECAUTIONS AND FIRST AID: Take all necessary precautions to prevent eye and skin exposure to this product.

- If on skin, wash off immediately with soap and water.
- If in eyes, wash with clean water for 15 minutes and get medical attention. Do not delay.
- If swallowed, do not induce vomiting. Get immediate medical attention.
- Take labelled container to doctor.

16. STORAGE: Store product in a cool, dry place.

17. WHERE AVAILABLE:

Additional information available from:

BASF Canada Inc.
10 Constellation Court
REXDALE, Ontario
M9W 1K1

BASF Canada Inc.
Norcen Tower, Ste. 1705
715 - 5 Avenue S.W.
CALGARY, Alberta
T2P 2X6
Phone: (403) 263-1652

PYRAMIN (pyrazon)

1. FORMULATIONS: Flowable formulation containing 470 g/L of pyrazon in 3 L jugs.

2. REGISTERED MIXFS: Pyramin can be mixed with triallate (Avadex BW), TCA, or Ro-Neet.

3. CROPS: Sugarbeets

4. WEED CONTROLLED: Black nightshade, buckwheat (wild), chickweed knotweed, lady's thumb, lamb's quarters, mustard (wild, wormseed), oakleaved goosefoot, pigweed (prostrate, redroot), purslane, ragweed, shepherd's purse, smartweed, stinkweed, wild carrot, yellow rocket.

5. WEEDS SUPPRESSED: None

6. WHEN USED: Pyramin may be used as a pre-plant incorporated, pre-emergent or post-emergent treatment. However, in Alberta, a pre-plant incorporated treatment is recommended. Post-emergent treatments should be applied before the weeds have 3 leaves.

7. HOW TO APPLY:

With:	Ground equipment
Rate:	Light soils - 3.34 L/acre (8.25 L/ha) Heavy soils - 4.15 L/acre (10.25 L/ha)
Water Volume:	40 - 101 L/acre (100-250 L/ha)
Incorporation:	Pre-plant - incorporate shallow. Fall ridging - apply Pyramin in a 17.5 cm band and cover with a 15-20 cm high ridge of soil. In the spring, level the ridges and leave guide marks to enable planting the bands. Avoid levelling deeper than the chemical placement.
Pressure:	275-350 kPa
Ground Speed:	
Nozzles:	All standard low pressure nozzles delivering 40-101 L/acre (100-250 L/ha).
Protective Equipment:	Standard protective clothing used when applying herbicides. - plus a face shield and apron when opening jugs of Pyramin concentrate.

8. SPRAYING TIPS: The fall ridging technique seems to be the best application method in Alberta.

9. HOW IT WORKS: The active ingredient in Pyramin is absorbed by the roots and is translocated to the leaves.

10. EXPECTED RESULTS:

Weeds: If adequate moisture is present, the weeds will fail to emerge. If the soil is dry for a long period of time, weeds

which emerge and become well established will not be fully controlled, but small emerged weeds may die back, once adequate moisture is present.

Succeeding crops: No effect.

11. EFFECTS OF RAINFALL: Not applicable.

12. MOVEMENT IN SOIL: Pyramin does not move readily in the soil and cannot be leached out.

13. GRAZING AND CROPPING RESTRICTIONS:

Drift: Care should be taken to avoid drift onto sensitive plants such as rapeseed and mustard.
Grazing Restrictions: The tops of beets grown in Pyramin treated soil may be used for human consumption or fed to livestock.
Cropping Restrictions: None

14. TOXICITY:

- has very low acute mammalian toxicity
  oral LD_{50} rats = 3,030 mg/kg
- no short term or long term human health problems are associated with this product when used according to label.
- non-toxic to bees

15. PRECAUTIONS AND FIRST AID:

- If on skin, wash off with soap and water.
- If in eyes, wash for 15 minutes and get medical attention.
- If swallowed, induce vomiting. Give plenty of milk and water to drink. Get medical attention.
- Take labelled container to doctor.

16. STORAGE: Store in a cool, dry place. Do not store below 0°C.

17. AVAILABLE FROM: Oliver Agricultural Supply

Additional information available from:

BASF Canada Ltd.
10 Constellation Court
REXDALE, Ontario
M9W 1K1
Phone: (416) 675-3611

RO-NEET (cycloate)

1. FORMULATIONS: Emulsifiable concentrate 720 g/L (Ro-Neet 7.2 E).
Available in 4, 20 and 200 L containers.
Granules - 10% (Ro-Neet 10G).
Available in 20 kg. bag.

2. REGISTERED MIXES: Ro-Neet 7.2 E + liquid fertilizer
Ro-Neet + Nortron
Ro-Neet + Avadex
Mix restrictions: Compatibility test
Mixing with other pesticides: Not recommended.

3. WEEDS CONTROLLED:

Annual Grasses	Annual Broad-Leaf Weeds
Barnyard Grass	Black Nightshade
Green Foxtail	Henbit
Yellow Foxtail	Hairy Nightshade
Wild Oats	Lamb's-quarters
	Purslane
	Redroot Pigweed

4. WEEDS SUPPRESSED: None

5. WHEN USED: Ro-Neet is usually applied in the spring before planting, soil incorporated. Ro-Neet may also be applied in mixture with Nortron during fall ridging.

6. HOW TO APPLY:

With: Ground equipment or equipment designed for application of granular herbicides.

Rate: Sugar Beets - use Ro-Neet 7.2E at 2.53 - 3.14 L/acre (6.25 - 7.25 L/ha) on mineral soils only. Use Ro-Neet 10G at 18 - 22.6 kg/acre (45-56 kg/ha) pre-plant incorporated on mineral soils only. Use higher rate on heavier soils and lower rate on light sandy soils.

Water Volume: 80 - 160 L/acre (200 - 400 L/ha) with Ro-Neet 7.2E.

Incorporation: Incorporation must be thorough for good weed control and should be carried out immediately (within minutes) after application. Several types of implements can provide satisfactory incorporation for spring applications - such as:

1. Hooded power-drive rotary tiller, which is set to uniformly mix to a 5 - 7.5 cm depth.

2. Tandem or one way discs set to 10 - 15 cm. On heavy and medium soils cross discing(at right angles to the first) is required for adequate incorporation. On light soils, disc once followed by harrowing for additional mixing and to level the seedbed.

For maximum weed control sow the crop immediately after incorporation.

3. Fall layering in conjunction with fall ridging.

Pressure:	150-250 kPa
Ground Speed:	9 km/h
Nozzles:	All standard and low pressure nozzles delivering approximately 80 - 160 L/acre (200 - 400 L/ha).
Protective Equipment:	Standard protective clothing used when applying herbicides. Plus a face shield and apron when opening containers of liquid concentrate.

7. SPRAYING TIPS: Use 80 - 160 L/ac (200-400 L/ha) high volume, low-pressure nozzles with Ro-Neet 7.2E to ensure maximum uniform coverage.

8. HOW IT WORKS: Ro-Neet is taken in by the roots and shoots of a germinating weed. It disrupts and stops further growth which kills the germinating weed. Ro-Neet is not persistent in the soil, however, it will provide effective weed control for approximately 6-8 weeks.

9. EXPECTED RESULTS: Weeds - Ro-Neet controls a wide variety of weeds at the time when weed control is essential. Ro-Neet controls the weeds before they can compete for moisture and nutrients needed by the crop. Since Ro-Neet is absorbed by the weed shoot, most affected weeds will not emerge. Numerous chlorotic and bleached shoots may be visible by removing the top few inches of treated soil.

Crop - Applied according to directions and under normal growing conditions, Ro-Neet will not harm the treated crop. However, during germination and early stages of growth, unusually cold and wet or hot and dry weather, insect, nematode or plant disease attack, the use of certain soil-applied systemic insecticides, highly saline or alkaline soil conditions, improperly placed fertilizers or soil insecticides, may create abnormal conditions that weaken crop seedlings. Ro-Neet used under these conditions could result in crop injury.

Conditions under which poor results may be expected:
1. Conditions not suitable for application and incorporation (i.e. wet, cloddy soils).

10. EFFECTS OF RAINFALL: Ro-Neet is soluble in water and excessive moisture may leach Ro-Neet from the surface. This is not generally a problem.

11. MOVEMENT IN SOIL: Ro-Neet will move readily in the soil.

12. GRAZING AND CROPPING RESTRICTIONS:

Drift: Danger from drift is low
Grazing Restrictions: Not applicable
Crop Use After Hail: No restrictions
Succeeding Crops: No restrictions

13. TOXICITY:

- has very low acute toxicity to mammals.
  oral LD_{50} rats = 3,160 mg/kg
- no short-term or long-term human health problems have been associated with this product.
- very toxic to fish; non-toxic to birds

14. PRECAUTIONS AND FIRST AID: Avoid breathing fumes or spray mist. Do not get on skin or in eyes.

- If on skin, wash off with soap and water.
- If in eyes, wash for 15 minutes.
- If swallowed, do not induce vomiting. Get medical attention.
- Take labelled container to doctor.
- Take the information on this herbicide with you to the doctor.

FOR PHYSICIAN:

1. Do not induce vomiting or lavage stomach. Aspiration pneumonia from solvent (kerosene) may complicate or overshadow poisoning.
2. Give symptomatic and supportive treatment. Consult your local Poison Control Center for additional information.

15. STORAGE: Ro-Neet 7.2E must be protected from temperatures below -6°C. At temperatures below this, the product will crystallize. Do not store Ro-Neet near any seed or fertilizers.

16. WHERE AVAILABLE: From major grain companies and many independent farm supply dealers.

Additional information available from:

Chipman Inc.
P.O. Box 965,
Winnipeg, Manitoba
R3C 2V5
Phone: (204) 772-0434

SODIUM TCA SOLUTION/NaTA (TCA)

1. FORMULATION: NaTA granular formulation containing 85% TCA acid equivalent as sodium salt. Sodium TCA solution formulation containing 645 /L acid equivalent present as sodium salt.
   Available in 25 kg bags and 20 L pails.

2. REGISTERED MIXES: TCA + Nortron TCA + Pyramin

3. WEEDS CONTROLLED: Green and yellow foxtail, barnyard grass.

4. WEEDS SUPPRESSED: Quackgrass

5. WHEN USED: Pre-emergence or post-emergence before sugarbeets have 4 leaves, and before the grasses are 5 cm tall.

6. HOW TO APPLY:

With:	Ground equipment
Rate:	(use the lower rate on light sandy soil) Post-emergence: Granular 1.82 kg/acre (4.5 kg/ha) Solution: 2.22-4.45 L/acre (5.5-11 L/ha) Pre-emergence: Granular 2.53-4.05 kg/ac (6.25-10 kg/ha) Solution: 4.45-6.07 L/ac (11-15 L/ha)
Water Volume:	40 L/acre (100 L/ha)
Incorporation:	Only applicable in spot treatment for quackgrass.
Pressure:	275 kPa
Ground Speed:	9 km/h
Nozzles:	No screens smaller than 50 mesh flat fan type nozzles.
Protective Equipment:	Standard protective clothing used when applying herbicides. - plus a respirator and goggles when opening bags of TCA. - plus a face shield and apron when opening containers of liquid concentrate.

7. SPRAYING TIPS:

   (a) Flush sprayer thoroughly after each use.
   (b) Adequate agitation needed during mixing to completely dissolve TCA. Pre-dissolve TCA in a small amount of warm water to ensure quick and complete mixing.
   (c) Use 50 mesh screens and filters. Stainless steel and hardened stainless steel nozzle types are recommended.
   (d) Remove all nozzles and screens after use and wash in water.

8. MODE OF ACTION: TCA is absorbed more through the roots than by the foliage. It precipitates proteins within the plant, which are essential for growth. It also changes conformations of specific enzymes.

9. EXPECTED RESULTS: Lightening of green coloration is the first noticeable effect of TCA on green foxtail. Browning of the leaf tips, growth retardation and eventual death of the grass follows.

   Poor results may be expected under dry soil conditions.

10. EFFECTS OF RAINFALL: A light rainfall on newly treated soil is beneficial. However, due to high water solubility, it is not tightly adsorbed. Leached by heavy rains.

11. MOVEMENT IN SOIL: TCA acts mainly through the soil so activity will be greatest on sandy soil and under good moisture conditions.

12. GRAZING AND CROPPING RESTRICTIONS: Do not graze treated areas. Do not feed tops to livestock.

13. TOXICITY:

- has very low acute mammalian toxicity

Acute Toxicity Test	Animal	Result mg/kg
oral LD_{50}	rat	3320
oral LD_{50}	chicks	4280
oral LD_{50}	rabbits	4000
LC_{95}	fish	10000 ppm active in water

- may cause skin and eye irritation
- may cause burning if on skin for long time
- no short term or long term human health problems have been associated with this produce when used according to label.

14. PRECAUTIONS AND FIRST AID: Avoid skin and eye contact, do not inhale spray mist or dust particles.

- If on skin, wash off immediately with soap and water.
- If in eyes, wash for 15 minutes and get medical attention.
- If swallowed, give a neutralizer such as lime water, magnesium oxide or amphogel by mouth. Keep patient warm and get medical attention immediately.
- Take labelled container to doctor.
- Give opiate for control of pain.

15. STORAGE: Keep in dry storage. Frost does not affect granular NaTA. Liquid TCA should not be in storage at temperatures above 30°C, also keep from freezing.

16. WHERE AVAILABLE: Federated Co-operatives, Niagara Chemical Dealers, Pfizer Chemical Dealers, Alberta Wheat Pool, Oliver Agricultural Supply, Pioneer Grain and United Grain Growers.

Additional information available from:

Granular

Hoechst Canada Inc.
295 Henderson Drive
REGINA, Saskatchewan
S4N 6C2
Phone: (306) 942-1500

Solution

Pfizer
Agricultural Chemicals Div.
2140 Notre Dame Avenue
WINNIPEG, Manitoba
R3H 0K1
Phone: (204) 632-5126

CHEMICAL INSECT CONTROL

Introduction

Insect pests are present on most crops in Alberta. The degree of infestation and the severity of damage vary drastically from area to area and season to season.

Most pests, are sporadic and require occasional control during periods of abundance which may last from one to three years. Some pests, such as flea beetle, occur quite frequently and can inflict heavy damage on the sparse stand of tiny seedlings unless timely treatments are applied.

To insure proper use of insecticides, monitor your fields and do not panic when you see an insect in your crop, especially when the beet plants are large and the insect infestation is low. In such situations it is advisable to allow natural predators to multiply and control the low to moderate levels of infestations. Keep in touch with extension personnel to obtain information on pending pest problems and keep in mind the previous years' problems so you are prepared for changes in insect population levels.

Chemical Control

Attention to the following points should lead to more effective control. Insecticides will kill the pest insect if applied properly at a stage when the pest is susceptible. Information on the life cycle of the sugarbeet insect pests is included in this guide.

Safety

In general, insecticides are more toxic to humans, wildlife, fish, bees and other non-target organisms than herbicides. Follow label directions exactly for safety precautions associated with application of each insecticide. More information on safety is included with each insecticide write-up in this section.

Bee Safety

Honey bees and other pollinators are susceptible to most insecticides. Advise bee keepers in the area of pending insecticide applications at least 48 hours before application so they can protect their bees. Never allow insecticide spray to drift directly onto an apiary site. Do not apply insecticides to temporary or permanent water bodies which may be used by bees.

Livestock and Residues

All insecticide labels provide a waiting period between application and harvest, feeding to livestock, or grazing. These restrictions must be followed to prevent illegal residues and eliminate hazards to the end user of the crop.

An outline of the major problem insects together with a brief description of their control and detailed inforration on each of the insecticides follows.

INSECT CONTROL RECOMMENDATIONS FOR SUGARBEETS

When insecticides are used for the control of insects, the information on the LABEL should be studied and the instructions that are given should be followed. The information provided in this table is intended only to serve as a guide for easy reference to assist you in selecting the appropriate insecticide for a particular insect pest.

INSECT	CHEMICAL	APPLICATION RATE
ROOT MAGGOT	Counter 15G	3.23 kg/acre (8 kg/hectare)
	Temik 10G	0.75 to 4.5 kg/acre (8.4 - 11.2 kg/ha)

Chemical should be used where infestation is known or likely. Apply with granular applicator on drill, directing granules into seed furrow as it closes so that some soil falls onto the seed before the granules enter the seed furrow. Early planting helps reduce potential insect damage.

WIREWORM	Counter 15G	3 kg/acre (7.3 kg/hectare)

Wireworm population build up is usually a slow process because the beetles do not move far. An effective treatment used on grain in the rotation should give adequate control for subsequent beet planting. Counter controls wireworm when applied as for root maggot.

FLEA BEETLE	Guthion 2.4 EC	110 ml/acre (270 ml/hectare)

Apply when insects appear. Watch fields when beets are small and apply overall treatment promptly if insect damage warrants it.

CUTWORM	Lorsban 4 EC	560 ml to 1130 ml/acre (1.4 to 2.8 L/hectare)

Check fields closely as early detection and treatment prevents serious damage. Overall spray in late afternoon.

SPINACH CARRION BEETLE	Dylox	320 to 570 ml/acre (0.8 to 1.4 L/ha)

LEAF MINER	Dylox 8 EC	320 ml to 570 ml/acre (0.8 to 1.4 L/hectare)

Apply overall treatment if damage appears significant.

WEBWORM	Dylox 8 EC	320 ml to 570 ml/acre (0.8 to 1.4 L/hectare)

When moth or eggs are in evidence check underside of leaves carefully. Apply treatment when worms are small. Avoid spraying if infestation is very low and little leaf damage is anticipated.

AMBUSH, POUNCE (permethrin)

1. FORMULATIONS: Emulsifiable concentrates -
   Ambush (500 g permethrin/L)
   Pounce (384 g permethrin/L)

2. MARKETING CATEGORY: Commercial

3. HOW IT WORKS: Permethrin is a synthetic pyrethroid insecticide which works by contact on a wide range of pests. Good residual activity. No systemic or fumigant activity.

4. NUMBER OF APPLICATIONS: Repeat as necessary.

5. HOW TO APPLY:

With: Ground Equipment only.

Rate: Crop	Insect	Formulation	ml/ac	(ml/ha)
Sugarbeets	Cutworms (army, pale western, red-backed)	Ambush	90-120	(225-300)

Notes:
1. Rate range - use the high rate for heavy infestations (anticipated or actual), or when foliage is dense, or when soil is dry .

Water Volume: 130 - 180 L/ac (325-450 L/ha)

Protective Equipment: Wear protective clothing including rubber gloves and goggles when handling concentrate.

6. GRAZING AND CROPPING RESTRICTIONS: Do not feed any crop treated with permethrin to livestock.

7. TOXICITY: Acute oral LD_{50} = 430 - 4000 mg/kg (rat)

8. SAFETY:

Toxicological information (for the physician): Treatment of systemic intoxication should be primarily symptomatic and supportive. In cases of ingestion, carry out gastric lavage with care to prevent aspiration.

First Aid:
IF SWALLOWED - DO NOT induce vomiting or administer liquids; product contains petroleum distillates. Go immediately to nearest Physician.

IF IN EYES - flush with water for at least 15 minutes. Get medical attention.

IF ON SKIN - remove contaminated clothing at once. Wash with soap and water.

9. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN. Severe eye irritant. Avoid contact with eyes, skin or mouth. Avoid breathing spray mist. Wash thoroughly with soap after using and before eating or smoking. Keep in original container during storage. Do not contaminate food or feed. Keep product away from fire, open flame, lighted electric bulbs and other sources of heat. Toxic to fish; do not apply where streams, lakes, ponds or water may be contaminated. Toxic to bees and other beneficial insects. Do not spray when bees are foraging.

10. STORAGE: Do not store in or around the home, or near food or feed.

11. DECONTAMINATION AND DISPOSAL: Rinse empty bottle 3 times with clean water, each time disposing of rinse in the spray tank. Break rinsed bottle and cap and dispose of in garbage.

12. WHERE AVAILABLE: Alberta Wheat Pool, United Grain Growers, Pioneer Grain, Green Cross Product Dealers, Oliver Agricultural Supply, Pfizer Chemical Dealers and most pesticide suppliers.

Additional information available from:

Chemagro Limited
1355 Aerowood Drive
Mississauga, Ontario
L4W 1C2
Phone: (416) 625-5280

Chipman Inc.
P.O. Box 965,
Winnipeg, Manitoba
R3C 2V5
Phone: (204) 786-3421

COUNTER (terbufos)

1. FORMULATIONS: Granules - Counter 15-G (15% terbufos)

2. MARKETING CATEGORY: Restricted (products to be stored or displayed apart from food or feed).

3. REGISTERED MIXES:

4. HOW IT WORKS: Terbufos is a systemic, organophosphorus insecticide with effective initial and residual activity against soil insects and other arthropods.

5. NUMBER OF APPLICATIONS: One, applied in seed furrow but after soil has covered the seed.

6. HOW TO APPLY:

With: Ground Equipment
Rate:

Crop	Insect	Formulation	kg/ac	(kg/ha)
Sugar beet	Sugarbeet root maggot wireworm	15G 56 cm spacing	3.23	(8)

Incorporation: Sugar beets - apply in furrow, 5-8 cm behind the seed drop zone after some soil has covered the seed.

Protective Equipment: Protective clothing and respirator. Rubber gloves while handling product or treated seed.

7. APPLICATION TIPS: Do not apply later than at planting time. Do not place 15 G granules in direct contact with seed.

8. GRAZING RESTRICTIONS: Sugar beet tops and beet pulp may be fed to livestock after harvest.

9. TOXICITY: Acute oral LD_{50} = 1.6 mg/kg (rat)

10. SAFETY:

Symptoms of poisoning may include: weakness, headache, tightness of chest, blurred vision, non-reactive pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea and abdominal cramps.

Toxicological information (for the physician): Give atropine intramuscularly or intravenously depending on severity of poisoining, 2-4 milligrams (3-6 tablets of 0.65 mg each) every 10 minutes until fully atropinized as shown by the dilated pupils, dry flushed skin and tachycardia. Twenty or thirty milligrams, or more may be required during the first 24 hours. Never give

opiates or phenothiazine tranquilizers. Clear chest by postural drainage. Artificial respiration or oxygen administration may be necessary. Observe patient continuously for at least 48 hours. Repeated exposure to cholinesterase inhibitors may, without warning, cause increased susceptibilty to very small doses of any cholinesterase inhibitor. Allow no futher exposure to any cholinesterase inhibitor until cholinesterase regeneration has taken place as determined by blood tests. Prelidoxime chloride (2-PAM: PROTOPAM chloride) may be effective as an adjunct to atropine. Use according to label directions.

First aid: IN CASE OF EMERGENCY endangering life or property involving these products, call collect, day or night, 1-416-356-8310.

ATROPINE IS AN ANTIDOTE. Consult your physician about obtaining a supply of 0.65 milligram tablets for emergency use. If symptons include blurred vision, stomach cramps or tightness in chest, do not wait for a physician, but take two tablets at once. Do not take atropine unless symptons of poisoning have occurred. Anyone who has been sick enough to have taken atropine must be seen by a physician as soon as possible.

CALL A PHYSICIAN AT ONCE IN ALL CASES OF SUSPECTED POISONING

IF SWALLOWED - drink one or two glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person. Get medical attention.

IF INHALED: remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen.

IF IN EYES - immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention.

IF ON SKIN - immediately removed contaminated clothing and wash skin thoroughly with soap and water. Launder clothing before re-use. Wash thoroughly with soap and water before eating, drinking or smoking. Bathe at the end of the work day, and change outer clothing.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN. Poisonous by skin contact, inhalation or swallowing. Rapidly absorbed through skin. Repeated inhalation or skin contact may, without symptons, progressively increase susceptibility to poisoning.

DO NOT GET IN EYES, ON SKIN OR CLOTHING - Wear freshly laundered, long-sleeved work clothing daily. While transferring from package to equipment, wear a clean cap and gloves (rubber of cotton). If cotton gloves are used, they must be laundered or discarded after each day's use. Rubber gloves should be washed with soap and water after each use. Do not wear the same gloves for other work. Destroy and replace gloves frequently.

DO NOT BREATHE DUST - While emptying bags into equipment, pour downwind and allow as little free fall as possible. Do not pour at face level and do not allow dust to reach the breathing zone.

DO NOT CONTAMINATE FOOD OR FEED PRODUCTS.

Sweep up and bury spillage whether it occurs indoors or in the field. Once a bag has been opened, use it completely or bury the remainder. Make sure that the hoppers of equipment are emptied while still in the field. Cover granules that may be exposed on the ends of the treated rows, turns and field loading areas.

Keep all unprotected persons out of the operating areas. Keep out of reach of domestic animals. Not for use in or around the home. Highly toxic to fish, birds and other wildlife. Do not contaminate any body of water nor apply to any area not specified on the label.

12. STORAGE: Do not store in or around the home. Store apart from food or feed.

13. DECONTAMINATION:

Decontamination Solution - Into 10 L of water slowly and carefully add in sequence 130 g detergent followed by 525 g caustic soda (lye) and finally 1.2 litres of commercial bleach (sodium hypochlorite). Handle and use the solution with great care. Do not add water to dry lye.

14. DISPOSAL: Dispose of empty bags by delivering them to an approved landfill site for burial. DO NOT BURN.

If spill occurs on floor areas use a sweeping compound to clean up. Decontaminate the waste with decontamination solution. Wash floors with decontamination solution and rinse well with clean water. Clean up solution and rinse water with absorbent materials such as sawdust, sweeping compound, rags, etc. Dispose of waste and rinsings by burying in a non-crop, non-graze area away from all water supplies.

If spill occurs on the ground collect the material and dispose of it as above. Treat affected area with decontamination solution and cover with clean soil.

Wear the protective clothing described above during product decontamination and disposal operations.

13. WHERE AVAILABLE:

Independent Pfizer Chemical Dealers,

Additional information available from:

Cyanamid of Canada Ltd.
7121 H - 6 Street S.E.
Calgary, Alberta
T2H 2M8
Phone: (403) 253-0924

DYLOX (trichlorfon)

1. FORMULATIONS: Soluble Powder (SP) - 80% trichlorfon by weight)
Solution (SN) - (420 g trichlorfon/L)

2. MARKETING CATEGORY: Commercial

3. REGISTERED MIXES:

4. HOW IT WORKS: Trichlorfon is an organophosphate insecticide which works by contact and ingestion.

5. NUMBER OF APPLICATIONS:

Sugar beets - repeat as necessary.

6. HOW TO APPLY:

With: Ground or aircraft equipment.
Rate:

Crop	Insect	g/ac (g/ha) Powder	L/ac (L/ha) Liquid
Sugar beets	Beet Webworm	145-285 (350-700)	0.3-0.60 (0.7-1.5)
	Dipterous leaf miners, variegated cutworm	285-605 (700-1500)	0.60-1.1 (1.5-2.75)
	Beet armyworm	605-910 (1500-2250)	1.1-1.6 (2.75-4.0)

Notes: 1. Pre-harvest or pre-grazing interval (14 days).
2. Where a rate range is specified, use the low rate for immature insects, light infestations or sparse foliage. Exception - webworm control on sugar beets, use high rate with low volume aerial application.

Water Volume: Use sufficient water for thorough coverage.

Protective Equipment: Wear protective clothing; wear respirator and goggles if contact with spray mist cannot be avoided.

7. SPRAYING TIPS:

Mixing SP - powder dissolves readily in water and is suitable for use in all power-operated ground sprayers and aircraft sprayers. To dissolve in water, pour the required amount into full amount of water and then agitate. Use immediately after mixing. SP should be used in sprayers equipped with 0.3 mm or larger screens. If 0.15 mm screens are used, some screen clogging may occur.

Trichlorfon is a selective insecticide: beneficial insect species are less affected. This selective advantage is lost when product is used in conjunction with or alternated with non-selected pesticides.

8. GRAZING RESTRICTIONS:

Sugar beets - do not feed, tops harvested within 28 days of treatment.

9. TOXICITY: Acute oral LD_{50} = 144 mg/kg (rat)

10. SAFETY:

Symptons of poisoning may include: a sense of "tightness" in the chest, sweating, contracted pupils, stomach pains, vomiting and diarrhea.

Toxicological information (for the physician): Trichlorfon, an organophosphate insecticide, inhibits cholinesterase which process results in stimulation of the central nervous system. The antidote is atropine sulfate administered in large therapeutic doses repeated as necessary to the point of tolerance. 2-PAM is also antidotal and may be administered in conjunction with atropine. Do not give morphine. Watch for pulmonary edema which may develop in serious case of poisoning even after 12 hours. At first sign of pulmonary edema, the patient should be placed in a oxygen tent and treated symptomatically.

First aid: In case of poisoning call a physician immediately. Have patient lie down and keep quiet.

IF SWALLOWED: - vomiting should be induced. Administer milk or water freely and induce vomiting by giving one dose (15 ml) of syrup of ipecac. If vomiting does not occur within 10-20 minutes, administer second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. The patient should be lying down with the head below the foot level and facing down or to one side. Professional medical assistance should be secured immediately. Do not induce vomiting in an unconscious or convulsive person.

IF ON SKIN - remove contaminated clothing and wash skin immediately with soap and warm water.

IF IN EYES - wash immediately with flowing water for at least 15 minutes. Get medical attention.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN. May be harmful if swallowed, inhaled, or absorbed through the skin. Do not get in eyes or

on skin. Do not breathe dust or spray mist. Always wash thoroughly with soap and warm water after handling. Wash contaminated clothing with soap and hot water before reuse. Do not contaminate feed or food.

Do not apply Dylox to, or allow spray to drift onto, varieties of sorghum which are sensitive to phosphates. To do so may cause burning of the sorghum or milo.

Do not use on other crops used for food or forage. Use only according to label directions. Application at rates above those shown may result in illegal crop residues. Do not treat food crops grown in the greenhouse. To protect fish and wildlife, do not contaminate streams, lakes or ponds.

12. STORAGE: Store in a cool, dry area. Store the liquid formulations above $0^{o}C$ and away from excessive heat and open flame. Store in an area specially designated for pesticides. Do not store near any material intended for use of or consumption by humans or animals. Do not store in or around the home.

13. DECONTAMINATION AND DISPOSAL: Destroy empty container by burying at least 50 cm deep in a non-crop, non-graze area away from water sources or by burning - stay clear of smoke or fumes.

14. WHERE AVAILABLE: Oliver Agricultural Supplies, Alberta Wheat Pool, Pioneer Grain, Cargill Grain, Pfizer Chemical Dealers.

Additional information available from:

Chemagro Ltd.
#203, 610 - 70 Avenue S.E.
CALGARY, Alberta
T2H 2J6
Phone: (403) 259-2863

Chemagro Ltd.
1355 Aerowood Drive
MISSISSAUGA, Ontario
L4W 1C2
Phone: (416) 625-5280

FURADAN (carbofuran)

1. FORMULATIONS: Granular - 10G (10% carbofuran)

2. MARKETING CATEGORY: Commercial

3. REGISTERED MIXES:

4. HOW IT WORKS: Carbofuran is a broad-spectrum, systemic, carbamate insecticide, acaricide and nematicide which works by contact.

5. NUMBER OF APPLICATIONS:

   Granular - one per season.

6. HOW TO APPLY: Granular

Rate:	Crop	Insect	Formulation	kg/ac	(kg/ha)
	Sugar beet	Sugar Beet root maggot	10G	3.4	(8.5)

Apply directly into seed furrow at same depth as seed or slightly above seed. Do not mix seed, fertilizer and insecticide in same hopper.

Protective Equipment: Wear protective clothing and, if exposure to dust cannot be avoided, a pesticide respirator and goggles.

7. SPRAYING TIPS: Check the label for calibration of various types of granular applicators.

8. GRAZING RESTRICTIONS: Sugar beet tops and pulp may be fed to livestock without causing residues in milk or meat.

9. TOXICITY: Acute oral LD_{50} = 11 mg/kg (rat)

10. SAFETY:

Symptoms of poisoning: Typical cases involving blurred vision, nausea, excessive perspiration and a sense of weakness have been reported in formulators and applicators. Additional symptoms may include headache, light-headedness, constriction of pupils, cramps, salivation and vomiting.

Toxicological information (for the physician): Carbofuran is a reversible cholinesterase inhibitor. Give atropine 2 mg intravenously. If in eyes, instill one drop of Homatropine. Do not use oximes such as 2-PAM.

First Aid: IF SWALLOWED - vomiting should be induced. Do not induce vomiting in a convulsive or unconscious person. Administer milk or water freely and induce vomiting by giving

one dose (15 ml) of syrup of ipecac. If vomiting does not occur within 10 to 20 minutes, administer a second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. Patient should be lying face down or on side with the head below foot level. Professional medical assistance should be secured immediately.

IF INHALED - have victim lie down and remain quiet.

IF ON SKIN - remove contaminated clothing and immediately wash skin with soap and water.

IF IN EYES - flush eyes with plenty of water for at least 15 minutes. Call a doctor immediately.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN.

DANGER - Do not breathe spray mist or dust. Wear goggles at all times. Wear a respirator when breathing of spray mist or dust in unavoidable.

Wear coveralls at all times. Never handle product with bare hands - use rubber or neoprene gloves. Do not use leather or cloth gloves.

Wash hands, face, neck and arms thoroughly after handling product and before eating or smoking. Take a complete bath at end of day. Change clothing each day after using product. Wash clothes in detergent, bleach and hot water.

Do not contaminate feed of food. Keep out of areas inhabited by fish, birds and wildlife - this insecticide is highly toxic to such animals.

12. STORAGE: Store away from food and feed. Do not store in or around the home. Store in a safe, cool place.

13. DISPOSAL: Bury empty containers at least 50 cm deep away from water supply in a non-crop, non-graze area.

14. WHERE AVAILABLE: Alberta Wheat Pool, Oliver Agricultural Supplies, Cargill Grain, Pfizer Chemical Dealers, Pioneer Grain.

Additional information available from:

Chemagro Ltd.
1355 Aerowood Drive
MISSISSAUGA, Ontario
L4W 1C2
Phone: (416) 625-5280

Chemagro Ltd.
#203, 610 - 7 Avenue S.E.
CALGARY, Alberta
T2H 2J6
Phone: (403) 259-2863

GUTHION (azinphos-methyl)

1. FORMULATIONS: Spray concentrate (SC) - (240 g azinphos-methyl/L)
Wettable powder (WP) - (50% azinphos-methyl)

2. MARKETING CATEGORY: Restricted (to be stored or displayed apart from food or feed).

3. HOW IT WORKS: Azinphos-methyl is a contact, non-systemic, organophosphate insecticide and acaricide of long persistence.

4. NUMBER OF APPLICATIONS: One per season on sugar beets.

5. HOW TO APPLY:

With: Ground or aircraft equipment

Crop	Insect	Qty/ac	(Qty/ha)	Qty/ac	(Qty/ha)
		Liquid		Powder	
Sugarbeet	Flea beetles	110 mL	(275 mL)	60 g	(150 g)

*Notes: - Pre-harvest interval, (100 days before cutting for food, feed or forage).

Water Volume: Use sufficient water for thorough coverage - generally, a minimum of 32 L/ac (80 L/ha) with ground equipment and 16 L/ac (40 L/ha) with aerial application.

Nozzles: When spraying sugarbeets, wettable powder may be applied using any commercial tractor drawn or self-propelled field sprayer provided it is equipped with the following:
(i) nozzle tips no finer than 6502, 8002 or TK2 with nozzle screens no finer than 0.3 mm. The above tips will provide 40 L/ac (100 L/ha) when operated at 8 km/hr and 200 kPa.
(ii) 0.3 mm or larger line strainers or screens.

Note that felt filters, smaller nozzle tips or smaller screens will become clogged when using the wettable powder formulation.

Protective Equipment: Protective clothing, pesticide respirator, goggles and, when handling concentrates, rubber gloves.

6. SPRAYING TIPS:

Mixing: The wettable powder mixes easily with water. Mix the required amount of powder with a small quantity of water. Add this pre-mix through the screen while filling the sprayer tank or fill the tank to the required level and then add the pre-mix. Operate the agitator while mixing.

The spray concentrate forms ar emulsion when diluted with water and is suitable for use in all power-operated ground sprayers

and aircraft sprayers. To mix, pour the required amount of spray concentrate into full amount of water and then agitate.

Spraying: Work to windward. Protect sprayer operators from drift or mist. When low volumes of spray are applied, complete coverage and thorough application are essential for most effective results. Schedule applications in accordance with local conditions.

7. GRAZING RESTRICTIONS: Do not graze treated areas within 21 days of application.

8. TOXICITY: Acute oral LD_{50} = 11 mg/kg (rat)

9. SAFETY:

Symptoms of poisoning: A sense of 'tightness' in the chest, sweating, contracted pupils, stomach pains, vomiting and diarrhea.

Toxicological information (for the physician): Compound inhibits cholinesterase, resulting in stimulation of the central nervous system, the parasympathetic nervous system, and the somatic motor nerves. Do not give morphine. Watch for pulmonary edema which may develop in serious cases of poisoning even after 12 hours. At first sign of pulmonary edema, the patient should be placed in an oxygen tent and treated symptomatically.

Antidote - administer atropine sulfate in large therapeutic doses. Repeat as necessary to the point of tolerance. 2-PAM is also antidotal and may be administered in conjunction with atropine.

First Aid: In case of poisoning, call a physician immediately. Have patient lie down and keep quiet.

IF SWALLOWED: Vomiting should be induced. Administer water freely and induce vomiting by giving one dose (15 mL) of syrup of ipecac. If vomiting does not occur within 10 - 20 minutes, administer second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. The patient should be lying down with the head below the foot level and facing down or to one side. Professional medical assistance should be secured immediately. Do not induce vomiting in an unconscious or convulsive person.

IF ON SKIN: Remove contaminated clothing and wash skin immediately with soap and warm water.

IF IN EYES: Wash immediately with flowing water for at least 15 minutes.

10. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN.

Poisonous if swallowed, inhaled, or absorbed through the skin. Do not get in eyes or on skin. Wear protective clothing, natural rubber gloves, and goggles. Do not breathe dust or spray mist. Wear a pesticide respirator.

Do not contaminate feed or food. Keep all unprotected persons out of the operating area or vicinity where there may be danger of drift. Workers who must enter treated fields within 2 days of application should wear protective clothing. Wash hands, arms, and face thoroughly with soap and warm water before eating or smoking. Wash all contaminated clothes with soap and hot water before reuse.

Do not use on other crops used for food or forage. Use only according to label directions. Application at rates above those shown may result in illegal crop residues. Do not use on food crops grown in the greenhouse. To protect fish and wildlife, do not contaminate streams, lakes, or ponds. This product is highly toxic to bees exposed to direct treatment or residues on crops. Do not apply when crop is in bloom or allow spray to drift towards beehives.

11. STORAGE: Store wettable powder in a cool, dry place. Do not store spray concentrate below -4°C. Protect products from heat and open flame. Do not heat.

12. DECONTAMINATION AND DISPOSAL: Do not reuse container. Completely empty the container. Rinse empty drum by filling with water and adding 250 mL household lye/25 L water; punch holes in top and bottom and crush. Bury unused chemical, rinse solution and crushed container at least 50 cm deep in a non-crop, non-graze area away from water supply.

13. WHERE AVAILABLE: Alberta Wheat Pool, Cargill Grain, Oliver Agricultural Supplies, Pioneer Grain, Pfizer Chemical Dealers.

Additional information available from:

Chemagro Ltd.
1355 Aerowood Drive
MISSISSAUGA, Ontario
L4W 1C2
Phone: (416) 625-5280

Chemagro Ltd.
#203, 610 - 70 Avenue S.E.
CALGARY, Alberta
T2H 2J6
Phone: (403) 259-2863

LINDANE (gamma BHC)

1. FORMULATIONS: Dusts (12-75% gamma BHC by weight)
   Solutions (15.7 - 21.5%)
   Suspensions (10 - 49.9%)
   Wettable powders (16.6 - 50%)

2. MARKETING CATEGORY: Commercial

3. REGISTERED MIXES: Most commercial formulations of lindane for seed treatment are mixed with one, two or three fungicides (any of: benomyl, captan, carbathiin, maneb, TCMTB, thiram). The insecticide diazinon is added to some.

4. HOW IT WORKS: Lindane is an organochlorine insecticide which works by ingestion, by contact and has some fumigant action.

5. NUMBER OF APPLICATIONS: Once, as a seed treatment.

6. HOW TO APPLY:

With: Seed treater or as a drill-box mix.

Rate:

Crop	Insect	Rate
sugarbeets (seed treatment)	wireworms	Varies with formulation, follow label for specific dosage.

Notes: - When a rate range is given, use the high rate for severe infestations.
The most practical approach consists of treating a cereal crop for wireworm control in the rotation.

Protective Equipment: Rubber gloves when handling concentrated product or treated seed. Pesticide respirator and goggles when treating seeds. Coveralls.

7. APPLICATION TIPS:

8. GRAZING AND CROPPING RESTRICTIONS: Do not use treated seed for feed or food. Do not graze or feed livestock on treated areas for four weeks after planting.

9. TOXICITY: Acute oral LD_{50} = 88 - 91 mg/kg (rat)

10. SAFETY:

Symptoms of poisoning may include: nausea, vomiting, hyper-irritability, convulsions coma and other symptoms typical of organochlorine poisoning.

Toxicological information (for the physician): Lindane is an organochlorine insecticide. Barbiturates may be given to control convulsions. Oxygen may be indicated. Keep patient quiet. Avoid use of morphine and adrenalin.

First Aid: IF SWALLOWED - induce vomiting by sticking a finger down the throat or by giving syrup of ipecac. Rush patient to nearest hospital and take the container label with you. Because of all the formulations with fungicides, the label information will be important in providing medical treatment.

IF ON SKIN - remove contaminated clothing and wash skin with soap and water.

IF IN EYES - flush with plenty of water for 15 minutes. Get medical attention.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN.

Hazardous if inhaled, swallowed or absorbed through the skin. When handling product or treated seed, work in a well-ventilated area and wear a pesticide respirator, goggles, gloves and coveralls. Do not breathe the dust. After handling, wash thoroughly with soap and water (and before eating or smoking); change to clean clothing - launder clothing before wearing again.

Do not apply or allow entry into streams, lakes or ponds. Lindane is toxic to fish, birds and other wildlife - do not allow access to wildlife.

If treated seed is to be stored before use (dry, treated seed may be stored for several months), label as follows: "Poisonous to Man and Animals. Do Not Use as Feed. This Seed is Treated With Lindane for Control of Insects."

12. STORAGE: Store in a cool, dry place away from the home and away from food and feed. Liquid products may be frozen; crystals will dissolve when warmed to 0°C.

13. DECONTAMINATION AND DISPOSAL: Either burn empty containers, staying clear of smoke, or puncture and crush empty containers, then bury at least 50 cm deep away from any water source.

14. WHERE AVAILABLE: Most elevator companies and chemical dealers.

Additional information available from:

Chipman Inc.
Box 836
4605 - 101 Avenue
EDMONTON, Alberta
T5J 2L4
Phone: (403) 465-5849

Chipman Inc.
P.O. Box 965
WINNIPEG, Manitoba
R3C 2V5
Phone: (204) 786-3421

LORSBAN (chlorpyrifos)

1. FORMULATION: Emulsifiable concentrate - Lorsban 4E (480 g/chlorpyrifos/L)

2. MARKETING CATEGORY: Commercial

3. HOW IT WORKS: Chlorpyrifos has a broad range of insecticidal activity and works by contact, ingestion and vapour action. It is non-systemic and, at the recommended rates, non-phytotoxic.

4. NUMBER OF APPLICATIONS: Once per season as a seedling treatment of sugar beet.

5. HOW TO APPLY:

With: Ground equipment

Rate:

Crop	Insect	mL/ac	(L/ha)
Seedling: sugarbeet	Cutworms (red-backed, pale western)	485-970	(1.2-2.4)

Notes: - Pre-harvest interval of 90 days.
- Rate Change: use low rate for young insects, light infestations or sparse foliage.

Water Volume: Seedling sugarbeet - 32-80 L/ac (80-200 L/ha); all other applications require 80-160 L/ac (200-400 L/ha).

Protective Equipment: Long-sleeved work clothes and gloves when handling and in addition, pesticide respirator and goggles when exposure to spray cannot be avoided.

6. SPRAYING TIPS: Use the higher rates when the top 1 cm of soil surface is extremely dry or when the infestation is heavy or when foliage is dense. Early evening applications are best. Apply when damage first appears.

7. TOXICITY: Acute oral LD_{50} = 135-163 mg/kg (rat)

8. SAFETY:

Symptoms of poisoning: By inhalation - stuffy, runny nose, scratchy throat, asthmatic wheezing, sudden bronchospasm, swelling of oral and laryngeal mucous membranes, shock.

Toxicological information (for physician): Chloropyrifos is a cholinesterase inhibitor. Treat symptomatically. Atropine, by injection only, is an antidote.

First Aid: IF SWALLOWED - do not induce vomiting. Get medical attention. IF CONTACTED - flush eyes and skin with plenty of water. If in eyes, get medical attention.

9. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN.

In case of accident call a doctor. May be fatal if swallowed. May be absorbed through the skin. May be irritating to eyes and skin. Avoid contact. Do not wear contaminated clothing. Wash thoroughly after handling. Avoid breathing vapours or spray mist. Keep away from food, feed and water supply. Combustible liquid - keep container closed and away from heat and open flame. Do not contaminate water supply by rinsing equipment or waste disposal.

10. STORAGE: Keep container closed and away from heat and open flame. Store away from food and feed.

11. DECONTAMINATION AND DISPOSAL: Promptly crush empty containers and bury in locations isolated from water.

13. WHERE AVAILABLE: Alberta Wheat Pool, Oliver Agricultural Supplies, Federated Co-operatives, Cargill Grain, United Grain Growers, Pioneer Grain, Pfizer Chemical Dealers.

Additional information available from:

Dow Chemical of Canada Ltd.
P.O. Box 1012
SARNIA, Ontario
N7T 7K7
Phone: (519)

Dow Chemical of Canada Ltd.
2412 - 10025 Jasper Avenue
EDMONTON, Alberta
T5C 1S6
Phone: (403) 428-0440

MALATHION, CYTHION (malathion)

1. FORMULATIONS: Emulsifiable concentrates - 500E, 500, 50% (500 g malathion/L)

2. MARKETING CATEGORY: Commercial

3. HOW IT WORKS: Malathion is a non-systemic, contact, organophosphate insecticide and acaricide of brief to moderate persistence. Generally non-phytotoxic. Not effective below 20°C.

4. NUMBER OF APPLICATIONS: Repeat as necessary.

5. HOW TO APPLY: Emulsifiable Concentrates

With: Ground equipment or aircraft equipment

Rate:	Crop	Insect	L/ac	(L/ha)
	Sugar-beet	Flea beetles	0.45	(1.1)

Note: - No pre-harvest or pre-grazing interval.

Water Volume:

6. SPRAYING TIPS:

Sugarbeet: apply when insects or damage first appears.

All crops: do not apply when bees are present. Apply when day temperature is expected to exceed 20°C.

7. GRAZING RESTRICTIONS:

8. TOXICITY: Acute oral LD_{50} = 2800 mg/kg (rat)

9. SAFETY:

Symptons of poisoning: Headache, weakness, sweating, giddiness, blurred vision, nausea, abdominal cramps, diarrhea, and discomfort in chest.

Toxicological information (for the physician): If accidental poisoning occurs, atropine is antidotal. Pralidoxime chloride (2-PAM; PROTOPAM chloride) may be effective as an adjunct to atropine. For severe cases, administer 4-8 mg of atropine sulfate intravenously at intervals of 10-15 minutes until atropinization is achieved. For less severe cases, administer 2-4 mg intramuscularly at 30 minute intervals. When signs of full atropinization appear, reduce dosage and frequency to 1 mg every 2-4 hours. Full atropinization should be maintained for at least 24 hours from beginning of treatment. For children, administer proportionately lower dosages based on body weight.

First aid: In case of exposure move patient from area and remove contaminated clothing. Wash exposed skin with soap and water. IF IN EYES - flush with water. IF SWALLOWED - and patient is conscious induce vomiting by giving warm salty or soapy water. If breathing is weak or irregular give artifical respiration. Get prompt medical attention.

10. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN. Hazardous if swallowed, inhaled or absorbed through skin. Avoid breathing spray mist. Avoid contact with skin, eyes or clothing. Wash throughly with soap and water after handling. Remove contaminated clothing.

Do not contaminate food, feed, fertilizers or seed. Do not treat dairy barns. Do not apply to pastures while occupied by dairy animals. Do not treat any plants while in bloom. This product is also toxic to bees exposed to direct treatment or residues on crops. This product is toxic to fish. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes and containers.

11. DECONTAMINATION: Malathion breaks down rapidly in the presence of water and alkaline materials. Containers and spillages can be readily decontaminated by use of Javex or lye, or washing soaps containing sodium hydroxide. Residues of malathion can be buried in a suitable disposal area. First, place a layer of soda ash or hydrated lime at the bottom of a pit, then pour in the malathion, add another layer of soda ash or lime. Finally, cover with a mixture of Javex and water and top with soil. The amount of soda ash or lime and Javex will be dependent upon the amount of malathion to be decontaminated.

12. DISPOSAL: Empty containers may be filled with lye or strong soap solution and left to stand for 24 hours. After washing, dispose of solution in a lime bed. Crush and bury the containers.

13. WHERE AVAILABLE: Almost all pesticide dealers and suppliers carry Malathion EC. Grain companies and Oliver Agricultural Supplies carry grain protectant.

Additional information available from:

Cyanamid of Canada Ltd.
4204 - 109 Street
Edmonton, Alberta
T6J 2S8
Phone: (403) 436-0025

Chipman Inc.
19 Nebraska Road
Lethbridge, Alberta
T1K 3Z6
Phone: (403) 320-1335

TEMIK (aldicarb)

1. FORMULATION: Granular - Temik 10G (10% aldicarb)

2. MARKETING CATEGORY: Restricted

3. REGISTERED MIXES: Compatible with most fertilizers or pesticides. Do not use with alkaline materials such as lime.

4. HOW IT WORKS: Aldicarb is a soil-applied, systemic, carbamate insecticide. Soil moisture is required to release the active chemical from the granules (corn cob grits) so irrigation or rainfall should follow application. Uptake by roots is rapid; residual activity varies with dosage and pests involved but often lasts more than 6 weeks.

5. NUMBER OF APPLICATIONS: One application per year for field crops.

6. HOW TO APPLY:

With: Ground equipment

Rate: Crop	Insect	kg/ac	(kg/ha)
Sugarbeet	Sugarbeet root maggot	4.5	(11)

Incorporation: Furrow treatment-Apply granules in planting furrow just above seeds. Allow some soil to fall on seed so that direct contact between chemical and seed is avoided.

Protective Equipment: Wear protective long-sleeved clothing, goggles, respirator mask, and rubber gloves when handling.

7. APPLICATION TIPS: Calibrate and adjust application equipment to insure proper rate and accurate placement.

8. RESTRICTIONS: Do not harvest sugarbeets within 90 days of application. Do not harvest sugarbeet tops for livestock feed within 120 days of application. Do not use beet tops from treated beets as food for humans. Do not use plant parts for food or feed. Do not plant food crops in soil treated with this product for at least 1 year after treatment.

9. TOXICITY: Acute oral LD_{50} = 0.6 mg/kg (rat)

10. SAFETY AND PRECAUTIONS:

Symptoms of poisoning may include: weakness, headache, sweating, nausea, vomiting, diarrhea, tightness in chest, blurred vision, pinpoint pupils, abnormal flow of saliva, abdominal cramps, unconsciousness. Contact a physician immediately in all cases of suspected poisoning.

Toxicological information (for the physician): This product is a carbamate pesticide containing 2-methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl) oxime. It is a spontaneously reversible cholinesterase inhibitor causing parasympathetic nerve stimulation. Preferred treatment of poisoning is atropine sulphate given intraveneously. As much as 2-4 mg may be needed every 10-12 minutes until patient is fully atropinized. Dosage of children is appropriately reduced. Atropinization should be maintained for 12 hours by intramuscular administration of atropine in lower doses given at appropriate time intervals. Do not use opiates or cholinesterase-inhibiting drugs. Artificial respiration or oxygen may be necessary. Observe patient continuously for at least 24 hours. Allow no further exposure to any cholinesterase inhibitor until cholinesterase is regenerated and the level is normal by blood test.

First Aid: IF ON SKIN - wash immediately and thoroughly with soap and water and rinse well.

IF IN EYES - flush with plenty of water for 15 minutes.

IF SWALLOWED - cause vomiting immediately by putting finger down throat. Follow with plain water, and repeat until vomit fluid is clear. Do not induce vomiting or give anything by mouth to an unconscious person. Start artificial respiration immediately if patient is not breathing. If symptoms are apparent and person is conscious, administer atropine sulphate tablets by mouth as directed by the physician (two 0.6 mg tablets is the usual dose). Call a physician or transport patient to the nearest hospital or physician, whichever is faster. Show a copy of the label to the physician.

In case of emergency, telephone collect 24 hours a day 1 - (514) - 645-5311.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN. Harmful or fatal if swallowed, inhaled or absorbed through the skin. Rapidly absorbed through the skin and eyes. Do not handle with bare hands. Avoid contact with skin, eyes and clothing. Do not breathe dust. Wear protective, long-sleeved clothing, goggles, respirator mask and rubber gloves when handling. Wash hands and face before eating or smoking during working hours. After work, wash entire body with soap and water. Wash contaminated clothing and protective equipment in a strong solution of washing soda and rinse thoroughly before wearing again. Clean application equipment thoroughly after use.

Toxic to fish, birds and wildlife. Deep disc spills at row ends immediately to prevent birds from feeding on exposed granules. Do not contaminate any body of water. Do not mix granules directly with water. Do not use applicators that would grind granules. Do not apply to open blooms. Do not use in home garden.

12. STORAGE: Do not store in or around the home. Do not store or display near food or feed. Store indoors in an isolated, well-ventilated, clean, dry, cool area. Do not refrigerate.

13. DECONTAMINATION AND DISPOSAL: Dispose of any empty containers by delivering them to an approved landfill site for burial. Do not burn. If carton is broken, handle with rubber gloves.

If spill occurs on floor areas, use a sweeping compound to clean up. Decontaminate the waste with a solution of caustic soda, a strong commercial bleach and detergent. Wash floor with the decontamination solution and rinse well with clean water. Clean up the solution and rinse water with absorbent material such as sawdust, sweeping compound or rags. Dispose of waste and rinsings by burying in a non-crop, non-graze area away from all water supplies.

If spill occurs on the ground, collect the material and dispose of it as above. Treat the affected area with the decontamination solution and cover with clean soil.

Decontamination Solution - Into 10 L of water, slowly and carefully add in sequence 130 g detergent, followed by 525 g caustic soda (lye) and finally 1.2 L of commercial bleach (sodium hypochlorite). Handle and use the solution with great care. Do NOT add water to dry lye.

14. WHERE AVAILABLE: Pfizer Chemical Dealers, Oliver Agricultural Supply.

Additional information available from:

Union Carbide Agricultural Products Co., Inc.
77 City Center Drive
MISSISSAUGA, Ontario
Phone: (204) 745-3087

Medical Emergency: (514) 645-5311

THIODAN (endosulfan)

1. FORMULATIONS: Emulsifiable concentrate (400 g endosulfan/L)
   Wettable powder (50% endosulfan by weight)

2. MARKETING CATEGORY: Commercial

3. REGISTERED MIXES: Endosulfan is compatible with most insecticides and fungicides except Bordeaux mixture, hydrated lime, calcium arsenate or zinc sulfate.

4. HOW IT WORKS: Endosulfan is a non-systemic, organochloride insecticide/acaricide with both contact and stomach action. The molecule binds to a portion of the nerve membrane and interferes with ion transfer. The ion transfer imbalance sustains a repetitive nerve discharge, eventually resulting in total paralysis and death.

5. NUMBER OF APPLICATIONS: Sugarbeet (not more than once).

6. HOW TO APPLY:

   With: Ground or aircraft equipment.

   Rates:

Crop	Insect	Formulation	Qty/ac	(Qty/ha)
Sugar-beets	Green peach aphid	EC	0.60 L	(1.5 L)
	Beet webworm	EC	1.11 L	(2.75)

   Notes: 1. Pre-harvest or pre-grazing interval is 45 days

   Water Volume: Thorough wetting of all plant parts is essential for good results.

   Protective Equipment: Wear clean, synthetic rubber gloves, goggles and respirator.

7. SPRAYING TIPS: Mixing WP - fill spray tank nearly full and either pour recommended amount on water surface or pre-mix powder in a bucket half-filled with water then pour mix through screen into nearly filled spray tank. Finish filling tank. Keep agitator running during filling and spraying. Spray upper and lower leaf surfaces.

8. GRAZING AND CROPPING RESTRICTIONS: Do not feed treated crop refuse (vines, tops, stocks or threshings) or sugarbeet foliage to livestock. Sugarbeet roots may be fed. Succeeding crops - Do not apply to crops which are to be followed by a root crop other than carrots, potatoes, sweet potatoes or sugarbeets.

9. TOXICITY: Acute oral LD_{50} = 80-110 mg/kg (rat)

10. SAFETY:

Symptoms of poisoning: Nausea, headaches, general feeling of being unwell, followed by generalized convulsion.

Toxicological information (for the physician): Endosulfan is a central nervous system stimulant. There is no specific antidote. If patient is convulsing, give amobarbital-sodium or thiopental-sodium intravenously. Otherwise phenobarbital (0.06-0.10 gram) may be given orally. Do not use oil laxatives as they increase absorption. Do not give stimulants. Patient should be under medical observation for at least 24 hours in any case of suspected intoxication. Electroencephalogram may show abnormal alpha-wave activity.

First Aid: Wettable Powder and Dust: IF SWALLOWED - if patient is conscious, induce vomiting by giving patient one to two glasses of water and inserting a finger down the throat; repeat until vomit fluid is clear. If breathing is weak or irregular give artificial respiration. Get prompt medical attention bringing the labelled container with you. Do not give stimulants.

Emulsifiable Concentrate: IF SWALLOWED - Do NOT induce vomiting and avoid breathing vomitus into the lungs. Product contains petroleum distillates.

IF IN EYES - flush with plenty of water for 15 minutes and go to nearest hospital at once.

IF ON SKIN - remove contaminated clothing and wash skin thoroughly with soap and water.

11. PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN: Poisonous if swallowed, inhaled or absorbed through the skin. Avoid breathing spray mist or dust. Avoid contact with skin, eyes or clothing. Wear goggles, respirator, coveralls and synthetic rubber gloves when mixing or loading or when spray mist cannot be avoided. Wash with soap and water before eating, drinking or smoking. Change to clean clothing and wash contaminated clothing before reuse.

Do not contaminate any body of water. Do not apply or allow to drift to areas occupied by unprotected persons or animals. Do not contaminate feed or food. Highly toxic to fish. Moderately toxic to bees.

12. STORAGE: Do not store E.C. below -7°C. Do not store near foodstuffs, feed, fertilizers, seed or like commodities. Do not store in or around the home.

13. DECONTAMINATION AND DISPOSAL: For spilled powder, spread with sawdust or dirt to prevent scattering. Apply sodium carbonate, caustic soda or hydrated lime on contaminated area. After one hour collect with a shovel or a broom and wash paved areas with water. For spilled liquid, decontaminate with any of the above alkaline chemicals and allow to stand for one hour. Apply sawdust, talc, or sand to absorb all liquid. Decontaminate tools with hydrated lime. Bury unusuable or clean-up product 50 cm deep in an isolated area away from any water supply. Powder must be decontaminated while being buried by alternating layers of caustic soda or lime with endosulfan powder. When burying with clean-up absorbents from liquid spills, apply a layer of soda, caustic or lime on the top before filling the hole. Crush or puncture empty containers and bury 50 cm deep away from any water supply or take to the garbage dump.

PESTS THAT ATTACK SUGARBEETS

The following information on insect pests has been prepared by A.M. Harper and G.H. Whitfield, Agriculture Canada Research Station, Lethbridge.

SUGAR BEET ROOT MAGGOT

The sugar beet root maggot can be a major pest of sugar beets in Alberta. The population has been on the increase over the past few years and most areas where sugar beets are grown are now prone to maggot attack.

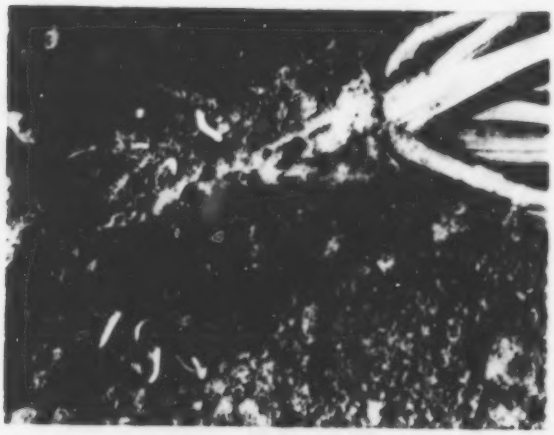
Life History and Crop Damage

Adult flies emerge from the soil in late May to mid-June. The adults are often seen on or near irrigation and farm equipment, flowering weeds and ditch banks. Approximately 10 days after emergence, eggs are laid in the soil around the beet seedlings. Eggs hatch in 1-3 days and the emerging maggots feed on the developing sugar beet roots. Feeding damage can kill small plants resulting in a reduced stand. In many cases, the beet plant continues to grow but feeding can lead to secondary root growth and loss of yield. Dark colored feeding channels may be observed in July on beet roots and often a rot caused by microorganisms will accompany this damage.

1. Eggs of the sugar beet root maggot

2. Adult, pupa, and larva of the sugar beet root maggot

3. Distortion of beet roots caused by sugar beet root maggots



4. Damaged sugar beets and sugar beet root maggots

5. Sugar beet field damaged by sugar beet root maggots

6. Sugar beet wilting from sugar beet root maggot damage

During hot sunny days in July, the beets damaged by maggot feeding will often wilt.

There is only one generation of sugar beet root maggots each year in Alberta. The final larval stage stops feeding in early August and remains dormant in the soil during the winter at a depth of 20-35 cm. The following spring, larvae develop into pupae which give rise to adults.

Description

The eggs of the sugar beet root maggot are white, slightly curved, slender, and laid in clusters of 10 to 20. The maggots are white, without legs, eyes, or distinct head, and can vary in length up to 12 mm. The pupa is in the soil in a brown pupal case, which is oval and slightly shorter than the maggot. The fly is shiny black and about 6 mm in length. Its transparent wings have a small dark area on the front margins.

Control

Sugar beet root maggot adults emerge from fields that were planted to sugar beets the previous year. They are strong fliers and are known to migrate to surrounding beet fields.

Sugar beet growers must decide before planting whether or not to treat for root maggots. Several granular insecticides are currently recommended for sugar beet root maggot control. These insecticides are applied in the row at planting. Some of the compounds can affect seed germination unless applied in the recommended manner. Growers are advised to treat their fields if root maggot damage has been observed in the area the previous year. An untreated strip of beets left in the field can be used as a check each year to determine if control is necessary.

Cultural procedures can reduce root maggot damage if feeding occurs. Growers are advised to plant early in a well prepared and well fertilized seed bed and to maintain adequate soil moisture through irrigation. There are no insecticides presently recommended that control the maggots once sugar beets become infested.

FLEA BEETLES ON SUGAR BEETS

Adult flea beetles *Psylliodes punctulata* Melsheimer can feed on sugar beet plants soon after seedling emergence in the spring. Feeding damage can lead to reduced plant growth and even death depending upon the density of beetles present and the growth stage of the sugar beet.

Damage

Plant injury is easily recognized by the appearance of round feeding holes on the leaves. These holes are formed when surface plant tissue is removed by chewing and the remaining tissue falls out producing a characteristic "shot-hole" feeding injury. In some situations when populations are high, the whole above-ground portion of the sugar beet seedling may be consumed at the 2-leaf or cotyledon stage, thus killing the plant. Reduced plant growth and wilting of foliage during hot, dry weather are other problems that can occur as a result of flea beetle feeding.

Life History and Description

Flea beetles spend the winter in the soil or under crop debris left in the field. During late April and early May they emerge. Adult beetles feed on leaves of various weed species and later migrate to feed on newly emerged sugar beet plants. The beetles are especially active when air temperatures are high, but will stop feeding and burrow back into the soil if the temperature drops.

The beetles lay their eggs in the soil close to host plants, including sugar beet seedlings in the spring. After hatching, larvae feed on plant roots and this may reduce plant growth in sugar beets. They complete feeding in 3 to 4 weeks and enter the pupal stage which gives rise to a second generation of adults. Each generation requires 5 to 10 weeks to mature from egg to adult. Damage to sugar beets is caused primarily by the spring generation when plants are in the seedling stage.

Adult flea beetles are small (2-4 mm), oval in shape, and shiny black. They have enlarged hind legs, which allow them to make sudden leaps when disturbed. They can often appear in swarms and are very active during warm, early summer days. The white colored eggs are 2 mm in length and are laid in the soil at a depth of 12 to 20 mm. The larvae are white, 3-4 mm in length at maturity and have dark brown heads. They form pupae which remain in the soil for up to two weeks, after which the adults emerge.

Control

Control programs are usually only directed at the adult flea beetle stage early in the spring when sugar beet seedlings are small and most susceptible to defol-

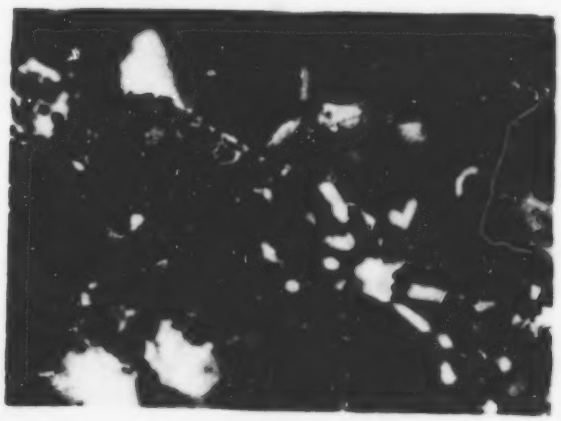


Figure 1. Severe flea beetle infestation.

Figure 2. Flea beetle adult on sugarbeet leaf.

ıation. Damage to roots by larval feeding is minor and control is not generally economical. Later generations of adult beetles can cause some feeding damage but sugar beet plants are able to compensate for this injury through increased summer growth.

Cultural control methods include clean cultivation, so various weed species such as mustard or lamb's-quarters are not present to serve as alternate hosts. Foliar insecticides can also be applied to sugar beets for control of the adults in the spring. Adult beetles can migrate or be carried by the wind from one field to the next, so long-term control may require more than one application. In some cases, control of flea beetles is also achieved when granular insecticides have been used at planting for control of other sugar beet pests. When adult populations are low and growing conditions are good, no chemical control may be necessary.

SUGAR BEET ROOT APHID

The sugar beet root aphid *Pemphigus betae* Doane attacks sugar beets in Western Canada and sucks the juice from the roots. The insect also infests table beets, swiss chard, and such weeds as lamb's-quarters.

Damage

The sugar beet root aphid sucks the sap from the roots of beets and can destroy most of the rootlets and severely damage the tap root. A few aphids will not appreciably change the appearance of the beets but large populations will cause the plant to wilt and, if enough sap is removed, the beets will die. As populations increase rapidly and are subterranean, fairly severe damage may be done before the aphids are noticed.

When an area is subjected to an early frost, damage is generally more severe on beets that are heavily infested with root aphids than on non-infested beets.

Life History and Description

The life cycle of the sugar beet root aphid is complex. At the time that leaves of the poplar open in spring, a wingless female known as the stem mother hatches from each of the overwintering eggs.

The aphid feeds on an emerging leaf causing it to bulge downward at the point of feeding until it forms a pocket or gall containing the aphid. In the gall the stem mother gives birth to 75 to 150 female young that are winged and have a black head and thorax and a green abdomen. Between late June and early August these winged forms fly or are blown in all directions. Many land on sugar beets where they produce pale yellowish-white, wingless aphids that damage the beet root.

These summer forms of the aphid are about 2 to 3 mm long and appear to be dusted with a white powder. The rear portion of the body produces a mass of white waxy material. The aphids are most readily seen in the white mold-like material that is found on the infested beet roots and in the surrounding soil. There are several generations on the summer host each year.

In late summer and early fall the wingless aphids on the beets produce large numbers of winged aphids, which fly back to poplars. These fall migrants are similar in form and color to the spring migrants. In protected places on the bark they give birth to several small, yellow, wingless aphids that are either males or females.

After mating, the female deposits a single white egg in a crevice in the bark of a poplar tree or under the bark of a dead branch, where it remains for the winter. It is only in fall that males are produced. Throughout the rest of the life cycle there are only females. These give birth

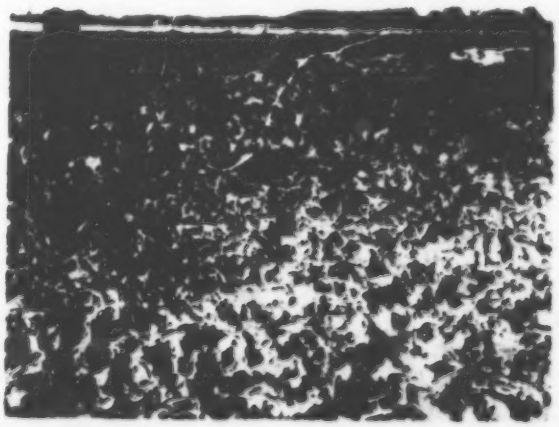


Figure 1. Sugarbeets damaged by sugarbeet root aphid.

Figure 2. Mold-like substance around sugarbeet root produced by sugarbeet root aphids.

Figure 3. Sugarbeet root aphids killed by fungus disease.

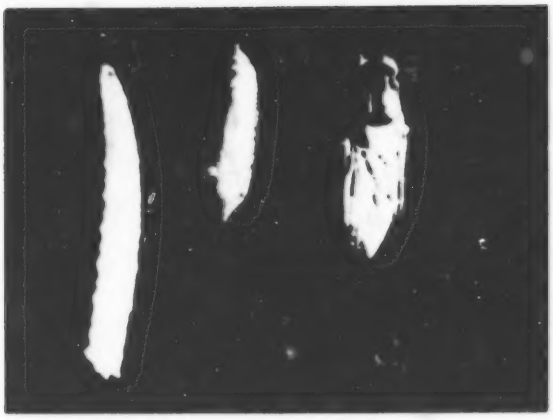


Figure 4. Life stages of the predator of the sugarbeet root aphid.

to other live female young without mating so populations can increase very rapidly.

Summer forms do not all produce winged migrants in fall; a small number continue to produce wingless forms. These overwinter in the soil in beet fields or on weeds in ditches and headlands and can become established on beets in spring.

Control

The best method of reducing damage by the sugar beet root aphid is to plant the sugar beets early, irrigate them early and frequently, and keep soil fertility at a high level to permit rapid, vigorous growth throughout the season.

In Alberta the aphid may be destroyed in galls by an anthocorid bug *Anthocoris antevolens* White, larvae of the hover fly *Syrphus bigelowi* Curran, a grey fly *Leucopis pemphigae* Malloch, and a ladybird beetle in the genus *Scymnus*.

In the soil the aphids on the beet roots are mainly controlled by the larvae of a small, black and yellow chloropid fly *Thaumatomyia glabra* Meigen. This predator has been found in every field of sugar beets in the province that has been infested with root aphids. In some fields heavily infested with root aphids there were an average of 150 larvae or pupae of the predator around each beet.

In some years a fungus disease *Entomophthora aphidis* Hoffman completely destroys all aphids in some fields, but in other years the incidence of the disease is negligible.

Chemical controls have not been satisfactory as the chemicals that destroy the aphids also destroy the predators. Aphid populations are usually about the same in chemically-treated plots late in the season as in untreated plots, but the untreated plots often have 4 to 5 times as many predators.

Figure 5. Gall on poplar leaf caused by the sugarbeet root aphid.

BEET LEAF MINER

The beet leaf miner, *Pegomya hyoscyami* (Panzer) is present in sugar beet growing areas of Western Canada, United States, and Europe. Although these insects often damage the sugar beet leaves in Alberta, the plants continue to grow, and yield is generally not affected.

Damage

The newly-hatched larva makes a hole in the outer covering of a leaf and feeds on the inner tissue making narrow thread-like mines. The mature larva produce large clear irregular blotches or blisters 12 to 15 mm in diameter. The destruction of the inner part of the leaf has the same effect as destruction of the entire leaf. In Alberta damage to young sugar beets has always been light, but older plants are quite often damaged. As the older leaves are the ones most frequently infested, and they are generally shaded by the newer leaves late in the season, they do not make a very significant photosynthetic contribution to the plant. Unless leaf mining is extensive, control of the insect is not necessary.

Life History and Description

The leaf miner overwinters as a pupa in the soil in sugar beet fields. The pupal stage is spent in a puparium, which is a brown covering made of the last larval skin of the maggot. The puparium is oval, brown, and about 5 mm long.

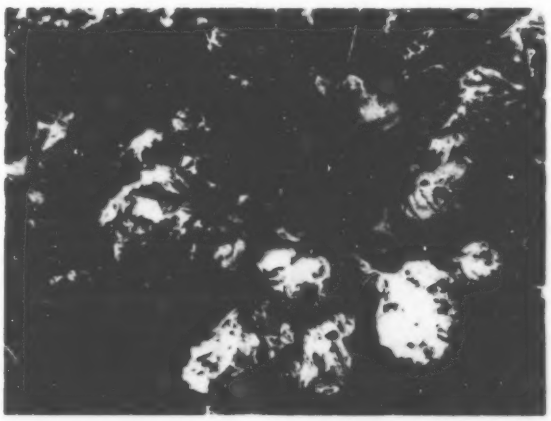


Figure 1. Sugar beet leaves damaged by beet leaf miner.

Figure 2. Beet leaf miner fly and eggs.

In late May the adult breaks open the puparium and crawls to the surface of the soil. The adult leaf miner is a grey fly with its body covered with long, stiff bristle-like hairs, and its abdomen bent downward and curved under. It is about 7 mm long and looks much like the common house fly. After mating the female places its eggs singly or in rows of 2 to 10 on the underside of the leaves of sugar beet or lamb's-quarters.

The eggs are white, elongate, and about 1 mm long.

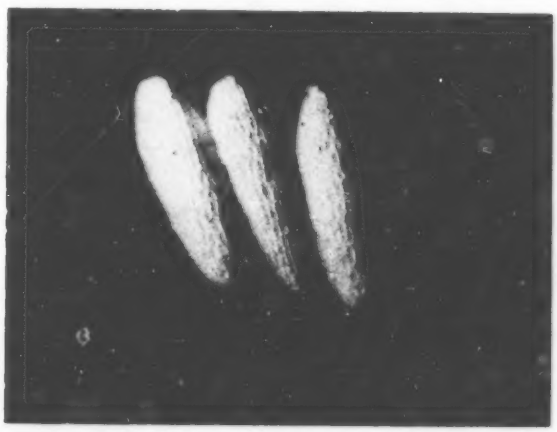


Figure 3. Beet leaf miner eggs.

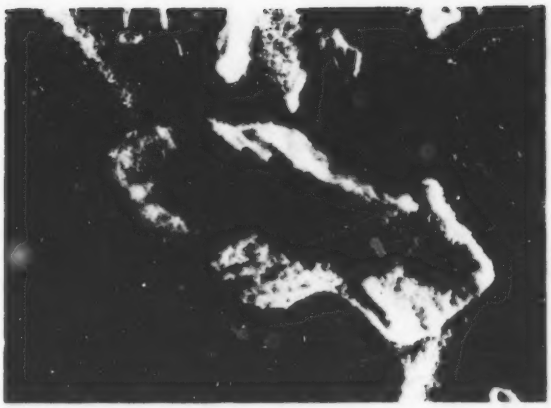


Figure 4. Diseased beet leaf miner in sugarbeet leaf.

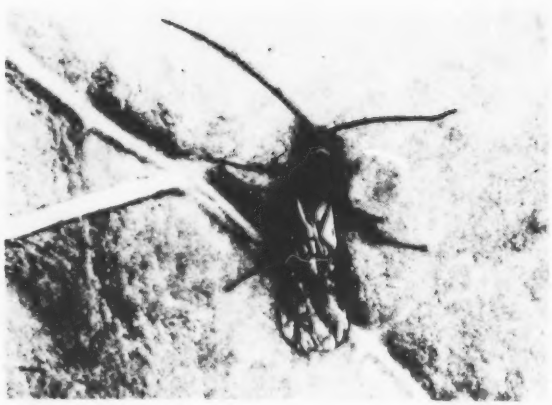


Figure 5. Parasite of beet leaf miner.

They should not be confused with the flat scale-like eggs of the beet webworm which may be present at the same time on the undersides of the beet leaves. When the eggs hatch, the tiny larvae eat holes through the surface of the leaf and feed between the upper and lower surfaces of the leaf.

The larvae are white or yellowish, without head or legs, and taper from front to back. As it is almost transparent, the green leaf tissue it consumes may be seen within the body.

When the maggot is full grown it emerges from the leaf and drops to the ground. It crawls beneath the surface to a depth of 5 to 8 cm, where it changes into a pupa. There is usually more than one generation a year.

Control

Leaf miners are attacked throughout the season by parasites, predators, and diseases which tend to keep them under control.

Destroying lamb's-quarters and other weeds in fields and ditches helps prevent the pest from becoming established on its weed hosts.

Planting early, maintaining high soil fertility, and providing adequate soil moisture enables the plants to resist the injurious effects of an infestation.

BEET WEBWORM

The beet webworm, *Loxostege sticticalis* Linnaeus, has been a sporadic, and at times, a serious pest of sugar beets in Alberta. The insect may also attack other broad-leaved hosts, but never seems to attack cereal grains.

Life History and Description

The eggs are small, creamy yellow, and disk shaped. They are laid, overlapping one another like shingles, on the underside of the leaves of such hosts as lamb's-quarters, Russian thistle, or sugar beets.

Hatching takes place in 7 to 10 days. The webworms are pale green and about 1-2 mm long. They feed on the undersides of the leaves and hang by threads from the leaves if the plants are shaken. Four to five weeks are required before they become full-grown. At this time the webworms are 25-40 mm long and are olive green with light and dark longitudinal stripes.

The webworm pupates in the soil in a soil-covered silken case which it constructs.

The adult webworm is a greyish brown moth about 20 mm long with a wing span of 25 mm. When at rest the moth appears triangular in shape. It makes short, rapid flights in a zig zag pattern which makes it easy to recognize.

There are two generations of webworms a year. The first generation of moths generally occurs between mid-May and early July, and the second generation from mid-July to the end of September. There is some overlap between the two generations.

Damage

The young webworms feed on the underside of the leaves. The older webworms eat holes through the leaves and sometimes leave only ragged veins. From a distance a heavily infested sugar beet field looks slightly brown and has a feathery appearance.

Control

Sugar beets should be checked carefully for eggs and young if moths are readily observed in the field. Large moth flights are not always followed by high numbers of webworms. When counts of webworms reach 1 or 2 per leaf on over half the leaves, control measures should be taken. Usually only the first generation of webworms causes serious problems.

Although parasites help keep the webworm under control, when a field is heavily infested the use of insecticides is the only satisfactory control method. Several insecticides are currently recommended for webworm control in Alberta. To control the insect quickly and effectively, insecticides should be applied before the webworms are half grown.

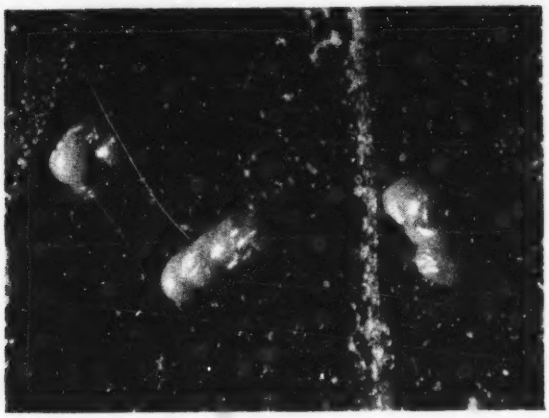


Figure 1. Eggs of sugar beet webworm.

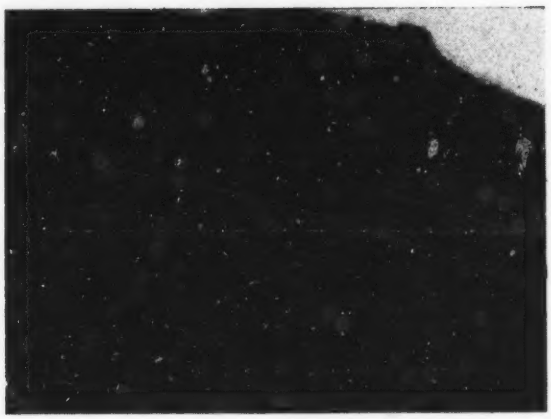


Figure 2. Early stage larva of sugar beet webworm.

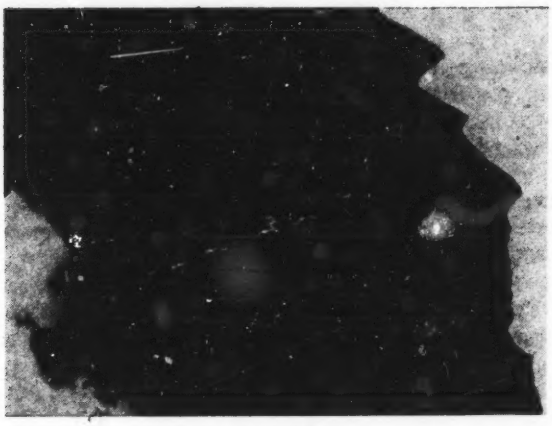


Figure 3. Full grown larva of sugar beet webworm.

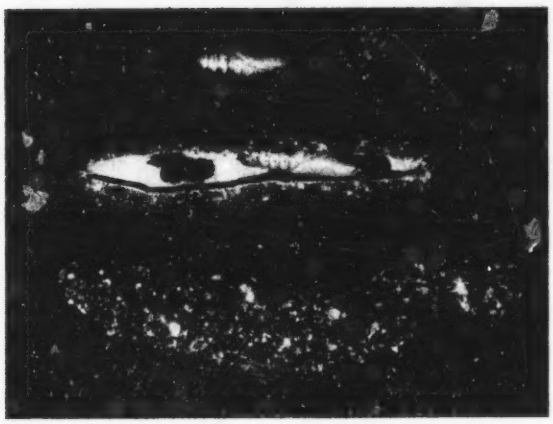


Figure 4. Pupa of sugar beet webworm.

Figure 5. Adult sugar beet webworm moth.

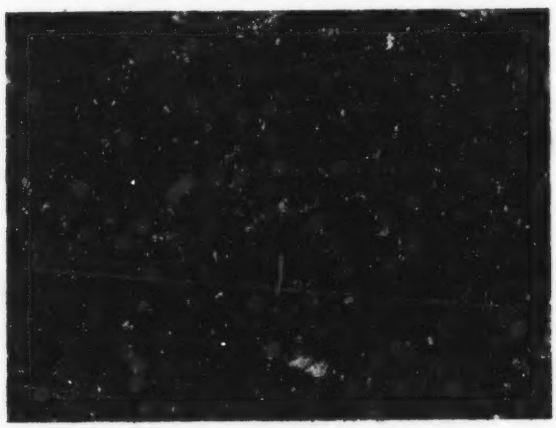


Figure 6. Beets damaged by the sugar beet webworm.

WIREWORMS ON SUGAR BEETS

Several species of wireworms, *Limonius* spp., can feed on sugar beets during the growing season and cause reduced plant growth or death of the plant. The variation in species present, differences in habitat and biology, and problems in detection make it difficult to predict when this insect will become a problem. Wireworms feed on many different crops, and sugar beets are particularly susceptible to feeding injury.

Damage

Wireworm larvae feed on sugar beet seed, reducing germination and the plant stand in the spring. Larvae also feed on the roots of seedlings and mature sugar beets. The tap root of seedling plants can be completely eaten or destroyed, resulting in death of the plant during unfavorable growing conditions. When growing conditions are better, secondary roots develop when the main tap root is damaged. Tunnelling and scarring of the root surface is also common. Girdling tunnels that wind all through the root and along its surface may be seen on mature sugar beets. These tunnels appear dark in color, almost black, and may be moist, indicating "bleeding" or loss of plant fluids.

Life History and Description

Wireworm larvae, depending upon the species, require anywhere from 2 to 6 years to complete development before forming pupae in late summer or early fall. Wireworm eggs are laid in the soil during May or June in many field crops, and especially in grassland areas. Wireworm larvae migrate downward late in the season as the soil becomes hot and dry. In the fall, depending upon the time of development, the larvae enter the pupal stage and after 3 to 4 weeks, adult beetles form. Wireworms therefore spend the winter as newly-formed adults or as immature larvae. In the spring, the larvae continue their feeding on plant roots, while the adult beetles emerge, mate, and lay eggs.

Wireworm eggs are small (less than 1 mm), opaque, and are difficult to observe in the field without the aid of a magnifying lens. The larval stage is 18 to 22 mm in length at maturity, white to dark brown, and hard-bodied. They appear somewhat flattened in shape, are many-segmented, and have a notch in the last (tail) segment. They have 3 pairs of short legs, located on the segments near the head. Pupae are 12 to 15 mm in length and appear white to shiny yellow. The legs are folded tightly

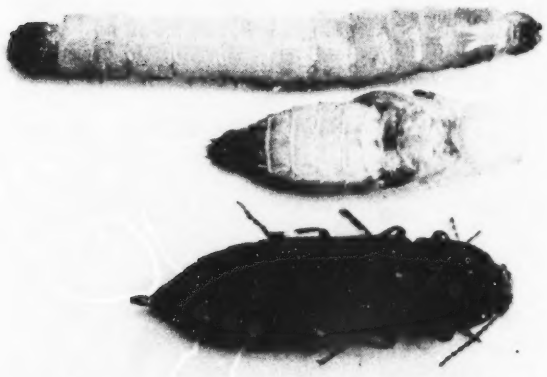


Figure 1. Larva, pupa, adult.

Figure 2. Wireworms and wireworm-damaged sugarbeet.

Figure 3. Healthy beet (left) and beets with various amounts of wireworm damage.

against the underside of the body and this stage remains inactive in the soil. The adult beetle is 6 to 15 mm in size depending on the species. It is light brown to black, elongate, and has two hard wing covers. Adults will "play dead" if disturbed and when turned onto their back, will spring into the air with an audible "click" sound. This click mechanism has given rise to their common name "click beetles."

Control

Crop rotation and cultural methods usually prevent wireworms from becoming a major problem in sugar beet fields. Because sugar beets are normally grown in a 4-year rotation in Alberta, crops less susceptible to wireworm attack can be grown on infested fields so populations will not build up. Root and row crops, such as potatoes, corn, onions, or beans, should not be grown in rotation where wireworms have been a problem. Wireworms can also be present when sugar beets are grown on land previously uncultivated or planted to grass or pasture. Deep ploughing in the fall and frequent cultivation in early summer is suggested when wireworms are known to be present in these fallowed fields.

Insecticides can also be used to reduce the wireworm threat. Use of seed treatment chemicals with a cereal crop in rotation with sugar beets is recommended for reducing wireworm populations in a problem field. Granular insecticides applied during sugar beet planting can also reduce wireworm populations and provide early season control. Chemical soil treatments, however, are usually not profitable unless populations of wireworms are high and extensive damage to sugar beets is imminent.

MISCELLANEOUS INSECT PESTS OF SUGAR BEETS

This paper discusses pests that injure sugar beets during the growing season. Most of these are not presently considered as major pests of the crop but occasionally they may become abundant enough to be of concern.

Spinach Carrion Beetle

Spinach carrion beetles, *Silpha bituberosa* Lec., will feed on seedling sugar beet plants in the spring both as larvae and as adults. They are often more of a problem along the field borders. Ragged edges of crushed plant tissue on the margin of plant leaves indicate their presence. The larva is shiny black, flat, and 6 to 8 mm in length. Adult beetles are dull black, somewhat flattened, have two hard "ribbed" wing covers, and when disturbed, will run for safety and crawl under clods of soil. This insect commonly migrates into sugar beet fields from nearby weeds, including lamb's-quarters and redroot pigweed. Removal of these weeds along field borders and clean cultivation will usually prevent populations from building up on sugar beets. Chemical controls are available if damage to sugar beets is extensive.

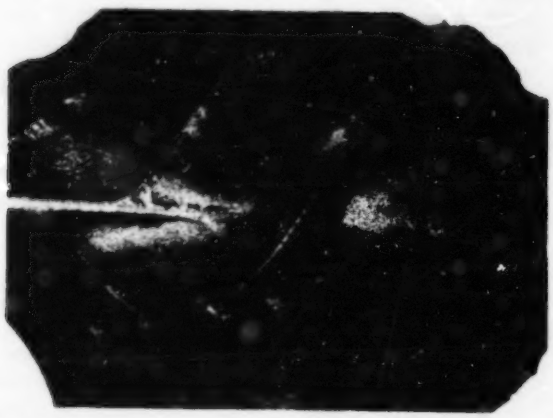


Figure 1. Spinach carrion beetle larva.

Figure 2. Spinach carrion beetle adult.

Cutworms

Several species of cutworms can damage sugar beet plants. These include the red-backed cutworm, *Euxoa ochrogaster* (Guenee), the darksided cutworm, *Euxoa messoria* (Harris), the variegated cutworm, *Peridroma saucia* (Hubner), and the early cutworm, *Euxoa tristicula* (Morrison). Adult cutworms are moths which lay their eggs in the soil on cultivated crops during the late summer. Larvae hatch from the eggs the following spring and either feed above ground on the leaves of sugar beet seedlings or cut the plants off at or near the soil surface. They are night feeders, spending the day curled up in the soil, at a 2 to 6 cm depth. The larvae are 2 to 5 cm in length when mature and are smooth skinned, dull-colored, and may be striped. There is normally only one generation each year, larvae developing to the pupal stage in midsummer. The early cutworm overwinters as an almost mature larva. In the spring it is capable of completely defoliating newly emerged sugar beet seedlings, often feeding on one plant and then the next down the row. Clean cultivation in the spring can help prevent cutworm

Figure 3. Redbacked cutworm.

larvae from developing on various weed species. Fields in rotation with sugar beets should also be cultivated for control of weeds. There are many natural enemies of cutworms, including parasites, diseases, and predators which can reduce larval populations considerably. Chemical controls can also be applied if cutworm populations are known to be high and plant damage is extensive.

Grasshoppers

There are many species of grasshoppers, *Melanoplus* spp., that feed on cultivated crops in western Canada and some of these have been known to damage sugar beets. Grasshoppers overwinter in the egg stage and young grasshopppers or nymphs which resemble the adults hatch out in the spring. Nymphs can feed on sugar beet seedlings, producing small, round holes on the leaves. In some years, when infestations are severe, whole leaves

Figure 4. Twostriped grasshopper.

can be devoured and plant growth is arrested. Damage is usually first seen on plants along the field borders, as the grasshoppers tend to migrate into sugar beet fields from dryland areas and adjacent roadsides. Feeding injury can also occur late in the season, when mature grasshoppers seek out new green plant tissue. Egg pods, each containing from 20 to 120 eggs, are laid in dry or uncultivated soil in late summer and fall. Weather conditions can greatly influence the abundance and time grasshopper populations appear. Eggs hatch earlier during warm, dry springs. An early population of grasshoppers can cause more damage when sugar beets are in the seedling stage. Cool, moist springs, good summer growing conditions, and the presence of natural enemies of the grasshopper can reduce the threat of injury by this pest. Chemical control methods are also available when natural controls fail to keep populations in check.

Sugarbeet nematode

The sugar beet nematode, *Heterodera schachtii*

Figure 5. Sugarbeets damaged by sugarbeet nematode and healthy beet (right).

Schm., can be an important pest of sugar beets causing considerable loss of yield when infestations occur. These nematodes are microscopic in size, live in the soil, and are parasitic on several species of plants, including sugar beets, cabbage, spinach, rape, and various weeds. Several generations can occur each year, and overwintering eggs hatch each spring when suitable host plants are present. Damage symptoms include the presence of stunted or killed plants in distinct areas of the field that slowly increase in size over a period of years. Damaged plants may wilt and have a greater than normal number of central small leaves. Injured beets can be easily pulled out of the ground and often will have a short tap root with an excess of hairlike roots. The bodies of female nematodes form cysts and these may be present on the roots of damaged plants. These small, pinhead-size cases are white to dark brown and contain hundreds of eggs from which nematode nymphs will hatch. Nematodes can move in the soil only a few centimetres each year but the cyst stage may be transported accidentally by man and machine

Figure 6. Sugarbeet nematode cysts on sugarbeet.

to infest other areas and fields. The primary control practice in Alberta involves the use of crop rotation. It is recommended that sugar beets be grown no more frequently than every fourth year and that a grain or hay crop be planted in the rotation cycle. This practice should prevent the population of nematodes in already infested fields from increasing to the level where they might produce economic losses to sugar beet yields. Although soil fumigation is possible under extreme circumstances, chemical control is not generally recommended. Strict adherence to a minimum 4-year rotation with no hosts of the nematode being planted during the rotation will prevent this pest from becoming a major problem on sugar beets in western Canada.